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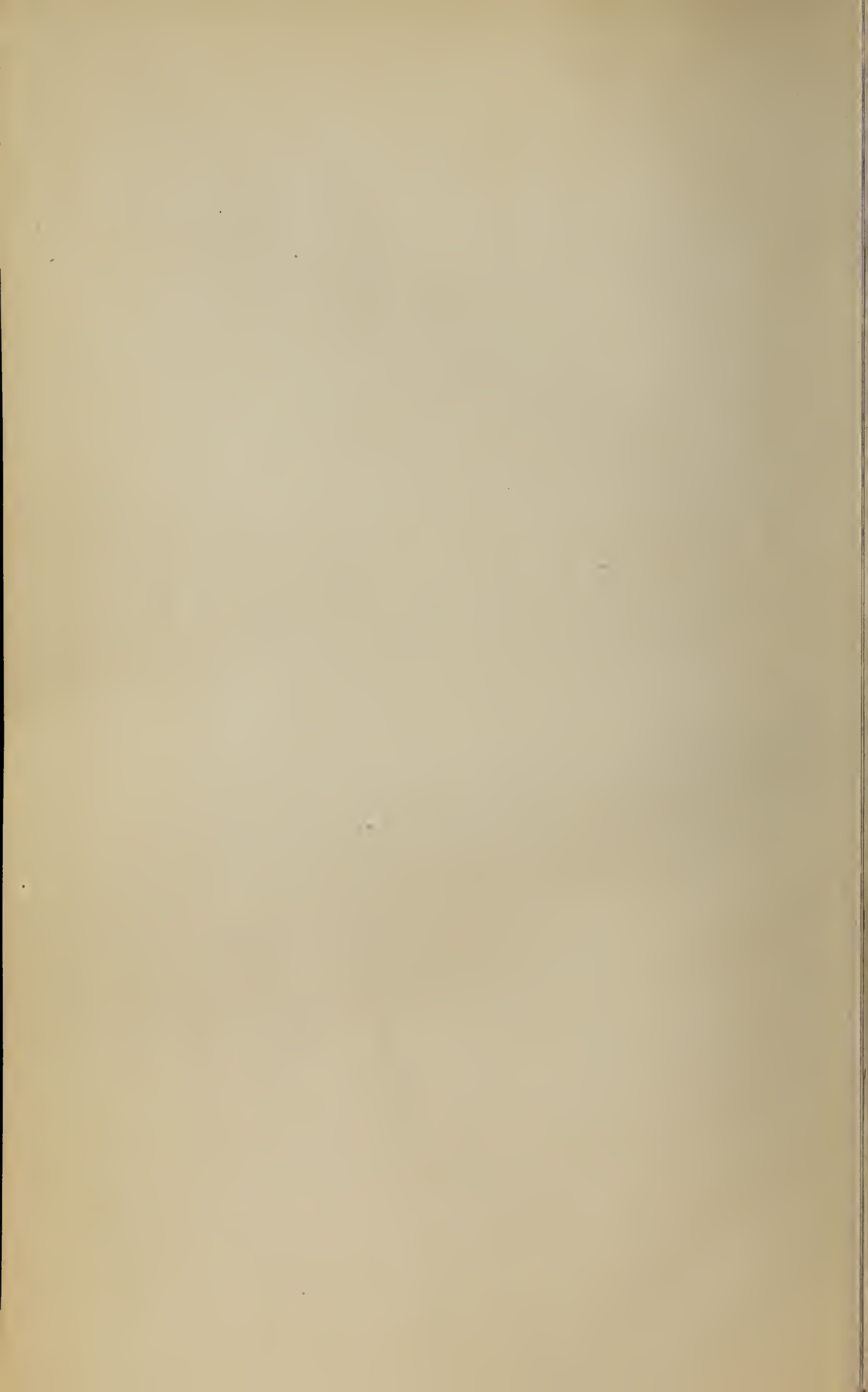
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THE
MIDLAND
NATURALIST

THE JOURNAL OF THE
"MIDLAND UNION OF NATURAL HISTORY SOCIETIES,"
WITH WHICH IS INCORPORATED THE ENTIRE
TRANSACTIONS OF THE BIRMINGHAM NATURAL
HISTORY AND MICROSCOPICAL SOCIETY.

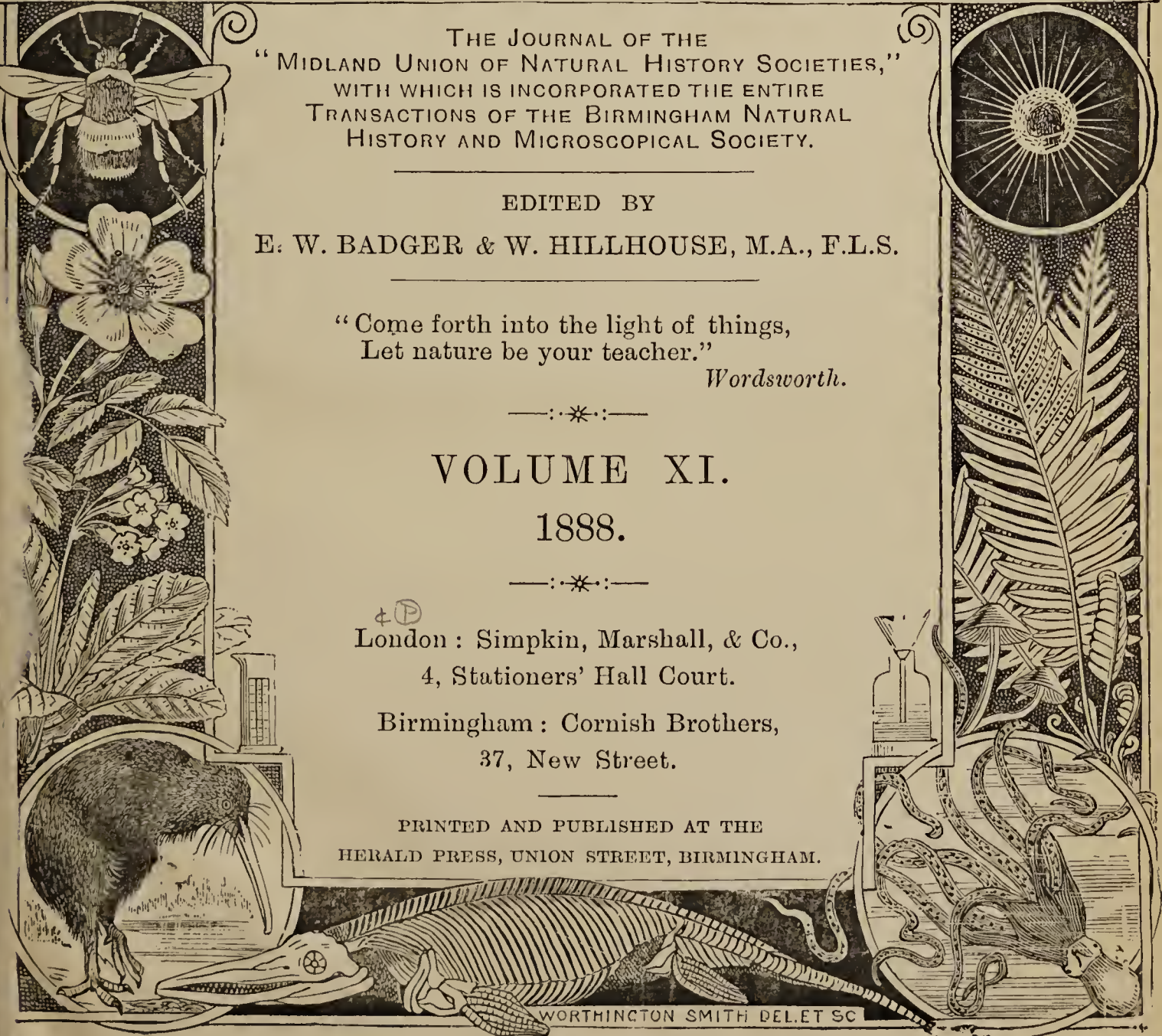
EDITED BY
E. W. BADGER & W. HILLHOUSE, M.A., F.L.S.

"Come forth into the light of things,
Let nature be your teacher."
Wordsworth.

VOLUME XI.
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PREFACE.

The completion of another volume of the "Midland Naturalist" once more gives us an opportunity, of which we gladly avail ourselves, of offering to all our fellow-workers a full meed of thanks for the kindly assistance they have rendered us. Amongst our contributors it gives us especial pleasure to welcome some new-comers; while, at the same time, many who have worked with us for years have still continued their valued and valuable co-operation. And to these we wish to add another group of contributors, whose labours are periodical and unostentatious, namely, the various secretaries through whose thoughtful care the reports of the meetings of the local Natural History Societies are provided for our pages.

Still, however, we want recruits. Whether the restlessness of foreign politics has affected us, or not, we cannot say, but we want to raise our peace footing to something considerably above its present strength, and our reserves are not nearly large enough for our wishes. No doubt a large increase in the ranks of our fellow-workers would diminish our own responsibilities, but we are quite prepared to face this contingency with equanimity.

Particularly we hope to enlist the sympathies and aid of more secretaries of Societies, so many of whom (belonging to the M. U. of N. H. S.) take no part in our work. If they would all make a point of sending to us reports of the meetings of their respective Societies, and would contribute, if only occasionally, some paper communicated to them, they would furnish a steady and reliable source of supply. Specially we would ask for the annual addresses of the various presidents, it being borne in mind that their appearance in the "Midland Naturalist" in no way affects disadvantageously, but rather facilitates, their separate publication, should this be desired. These addresses are generally of interest far beyond the circle to which they are delivered, and, as our experience has shown, would form a welcome and attractive feature in the pages of the "Midland Naturalist."

PRINCIPAL CONTRIBUTORS TO THIS VOLUME.

EDWARD W. BADGER, Birmingham.
 JAMES E. BAGNALL, A.L.S., Birmingham.
 J. G. BAKER, F.R.S., F.L.S., Kew.
 T. P. BLUNT, M.A., Shrewsbury.
 HORACE T. BROWN, F.G.S., F.I.C., F.C.S.
 R. W. CHASE, Birmingham.
 W. S. GRESLEY, Overseal.
 W. B. GROVE, B.A., Birmingham.
 W. JEROME HARRISON, F.G.S., Birmingham.
 ALFRED HILL, M.D., F.I.C., Birmingham.
 W. HILLHOUSE, M.A., F.L.S., Birmingham.
 W. R. HUGHES, F.L.S., Birmingham.
 W. P. MARSHALL, M.I.C.E., Birmingham.
 WM. MATHEWS, M.A., Birmingham.
 F. T. MOTT, F.R.G.S., Leicester.
 CONSTANCE C. W. NADEN, Birmingham.
 WM. PUMPHREY, Birmingham.
 J. SAUNDERS, Luton.
 REV. H. H. SLATER, B.A., Irchester.
 BEEBY THOMPSON, F.G.S., F.C.S., Northampton.
 CLEMENT L. WRAGGE, Government Meteorologist of Queens
 land.
 W. H. WILKINSON, Birmingham.

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FIG 1
MAGNIFIED 150 DIAM^S

ROCCELLA
PHYCOPSIS.

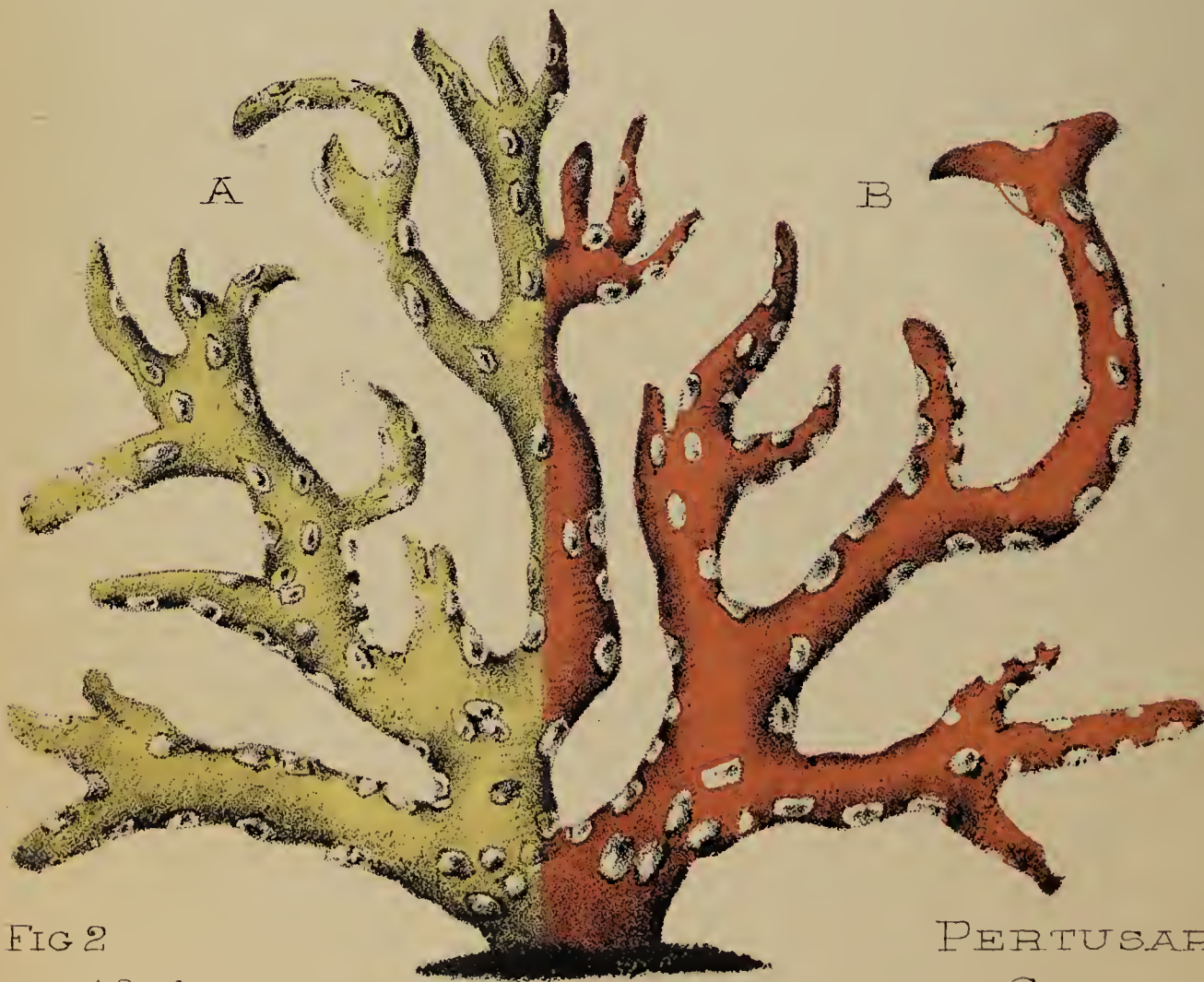


FIG 2
MAGNIFIED 4 DIAM^S

PERTUSARIA
COMMUNIS

COLOUR REACTION

THE MIDLAND NATURALIST.

"Come forth into the light of things,
Let Nature be your teacher."

Wordsworth.

COLOUR-REACTION: ITS USE TO THE MICROSCOPIST & TO THE BIOLOGIST.*

BY W. H. WILKINSON,
HON. SEC. OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

The rapid progress which has been made in nearly every branch of science during the last few years, is recognised by every student of Nature, and must lead to still further advance in the near future. Every fresh discovery made, and every new fact recorded, but opens a new door for fresh exploration and paves the way for new observation.

Thus the microscopist is constantly being enriched by the advance of optical science, and gladly avails himself of the improvements in the illumination of the object and the power and penetration of his lenses, and, as we are confidently told, the employment of the new German glass gives still further promise in this direction.

But the biologist not only needs all this, but more, and, while eagerly taking advantage of the improvements in optics, he applies to chemistry for acids and other solutions to disintegrate and separate and clear the various tissues he has to study. Thus when he has prepared delicate and thin sections, the chemist finds him various stains, which not only make his preparations look beautiful, especially in double

DESCRIPTION OF PLATE I.

FIGURE 1.—Thin section of a portion of an apothecium of a Lichen, *Pertusaria communis*, magnified 150 diameters, showing the asci and spores under the action of iodine.

FIGURE 2.—Thallus of Lichen, *Roccella phycopsis*, magnified 4 diameters.

A. Natural Colour.

B. Changed to Red by the action of Hypochlorite of Lime.

* Transactions of the Birmingham Natural History and Microscopical Society, Microscopical Section, April 5th, 1887.

staining, when either the contrasts or the blending of the colours are so effective, but which assist him in tracing the continuation of a given tissue or the course of a vascular bundle, or reveal the structure of the otherwise too transparent tissue. The advantages of mounting serial sections are also much enhanced by the delicate shades of colour produced by a careful use of double stains. Of course for mounting, the colours produced require to be permanent, but transient colours may be equally valuable as a test to the biologist.

Unstained sections are always the truest to Nature, and in many instances are sufficient for the biologist; but if no stains had been used, our present advance in the knowledge of the structure of the tissues composing living matter could never have been attained; as sometimes even a cell-wall will be so delicate and transparent that it requires the most careful treatment to reveal its presence.

Single stains are rendered valuable, as they colour some portions only of the structure while the other parts remain uncoloured; for instance, if the leaf of a Fern, *Pteris tremula*, after being "bleached," were submitted to the action of a carmine dye, the beautifully reticulated epidermis would remain unchanged, while the sori, spiral springs, and spores would all be stained carmine, and so at once easily recognised.

The foundation of double staining is that it is found from experiment that different colours affect different portions of the section, so that, for example, carmine and light green, being complementary to each other, please the eye; while each colour reveals its own portion of the structure.

Other double stains are needed, as some substances do not take the ordinary dyes, *i.e.*, a section of the Lichen, *Lecidea sanguinaria*, while unaffected by the usual dyes, may have its fruit (apothecia) coloured by an aqueous solution of Morrell's coral-red ink, and the remainder by an alcoholic solution of methyl green, giving brilliant results.

Besides the large number of useful aniline dyes now in the market, sections may be stained by many special methods which the worker will have to find out for himself. Sections treated with an iron solution first, then by cyanide of potassium, will develop a fine Prussian blue. They may also be coloured brown by soaking them in a solution of nitrate of silver, and, after the mounting is complete, by exposing them to the sun, when the silver will turn brown, and so reveal the portions it has penetrated.

It must be noted that in staining it is requisite to make the sections sufficiently dark to stand the subsequent process of mounting, but if too dark the delicate contrasts will be lost.

Perhaps in no department of biology is colour-reaction of more practical use than in the study of the Lichens. Nylander was one of the first to call attention to its value, but the principle had many a battle and many a struggle before it was accepted, and even now it is looked upon rather sceptically by some. Dr. Lauder Lindsay, having tried many hundreds of experiments, came to the conclusion that "there was nothing in it," as may be seen from the following extract from one of his papers on this subject:—

"These reactions occur of every degree of intensity, from the faintest and most obscure to the most brilliant and deepest. But in a far larger proportion of cases no reaction is exhibited at all; and in species in which it is usually developed it is capricious in the extreme—its development being apparently determined by the most trivial circumstances affecting (*e.g.*) the freshness or other condition on the one hand, and the reagent on the other. By reason of this extreme inconstancy of result, chemical characters cannot, I think, be relied on as furnishing a means of *determining species*. Certainly they have never afforded me any aid in this respect." *

But, fortunately, Dr. Lauder Lindsay recorded his experiments, and so they have been useful to others, although not to himself. And after many careful experiments, it was established that, given the same conditions, the same results might be looked for, so that after long waiting, *colour-reaction* has at last become generally accepted as a Lichen test. Thus Leighton in England, Nylander on the Continent, and many others, accept the principle, and use it largely and successfully in their work.

There are three principal reagents used:—

| | | | |
|----------------------|--------|------|----------------------------------|
| Iodine | | = I. | generally giving blue reactions. |
| Hypochlorite of Lime | = C. | „ „ | red „ |
| Hydrate of Potash | = K. | „ „ | yellow „ |

Iodine (as is well known in chemistry) possesses the property of turning starch and amyloid bodies blue, and so is generally applied to sections of the apothecia, when the asci are transformed from their plain semi-transparency to a delicate blue, thus rendering them at once visible, and their forms and positions may be easily ascertained. A reference to figure 1, plate 1, may render this more easily understood. The figure represents a section of part of an apothecium of *Pertusaria communis* $\times 150$, which when first cut is colourless,

* Transactions Bot. Society, Edinburgh, for 1869, p. 84.

but after the application of a weak solution of iodine, the beautiful blue colour is developed, as shown in the figure. This colour is transient and would fade in a hour in daylight, but may be kept much longer in the dark.

The lime and potash tests are generally used on the thallus or leaf-like portion of the Lichen, sometimes on the surface only, and at others on the medullary layer. The results may be negative, producing no change in some species, while others will give different colour-reactions, thus affording much help in determining species.

A glance at figure 2, plate 1, will show at once the striking effect of an application of the lime test C. to the thallus of *Roccella phycopsis*, the portion A representing its natural colour, while B shows the red colour produced by a touch of this solution. It may further be noticed that the soredia (those white patches scattered over its surface) are not affected in this species by the C. solution, while in *Roccella fuciformis*, a species very near it, the thallus itself is untouched by an application of the C. solution, while the soredia are coloured red. It will now be clear how useful this test is in deciding to which of these species a specimen belongs.

Leighton and some others not only use these tests in determining species, but also as a sufficient ground for forming new "varieties," or even new species, as, to quote from Leighton's Lichen Flora, "*Cladonia Flörkeana* var. *bacillaris*, K—, C—. Hitherto confused by external aspect and characters alone, with *Cladonia macilenta*, but separated by different reaction K yellow, C—."

While the classification of Lichens is generally based upon the spores, Leighton had found it more useful in *Lecanora* and *Cladonia* to make the colour-reaction of the thallus the basis of division, so that by carefully observing every effect of these colour-reagents a great help has been gained in the somewhat difficult study of the Lichens.

It may not be generally known that the litmus test papers, to be bought in almost any chemist's shop, are made from the Lichens of the genus *Roccella*. And it is probable that colour-reaction will before long form one of the standard tests of the biological laboratory.

In the far greater number of my own trials the results have proved the accuracy of Leighton's tests, and many times have I been able to name a Lichen which would have remained useless and undetermined but for the colour-reaction.

SOME INVESTIGATIONS INTO THE FUNCTION OF
TANNIN IN THE VEGETABLE KINGDOM.

BY W. HILLHOUSE, M.A., F.L.S.

(Continued from Vol. X., page 309).

The distribution of tannin in winter stems has been described by Sanio* in a few selected cases. In its general distribution, as seen in my own investigations, it is met with alike in assimilating tissues, such as leaves and cortex, and in storage tissues, such as medullary rays and pith in winter, and in the tissues of the leaf bases from which deciduous leaves have fallen or are about to fall. While generally present in the cell-sap of nearly every cell of the tissue concerned, tannin not infrequently has a definite distribution, as for example in vertical rows of elongated cells in the soft bast of *Phaseolus multiflorus* (kidney bean), in special tubular tannin vesicles of considerable length in the cortex and outer pith of *Sambucus nigra* (elder), and, together with starch, in cells forming a reticulum amongst the inner pith cells of very many dicotyledonous trees. Like starch, it is far less common in the aerial stems of Monocotyledons. This constant association of starch and tannin is curiously substantiated by Ebermayer:—"Alle guten Gerberinden sind ziemlich reich an Stärkemehl."† In general terms, my observations on the distribution of tannin tend to show that its presence in living tissues may be classified into—

- (1) In cells containing protoplasm and little starch, or starch in minute grains;
- (2) In cells containing starch, as reserve stores, and little protoplasm.

Cases of the first are generally cortical cells, and cells of the soft bast and bast rays. In these the whole contents of the cell, under the action of potassium bichromate, tend to collect into either a large ball, or a number of balls, of clear, bright, oily looking substance, highly refractive. In these cases it is probably always dissolved in the cell-sap, and in the interior of the protoplasmic body of the cell; under the action of the reagent this latter is killed, and more or less contracted; the tannin becomes partially diffused throughout the protoplasmic mass, partly passes outside it; the balls and masses formed by the reagent may, therefore, involve

* Sanio, "Einige Beobachtungen," u.s.w.; Bot. Zeit., 1863.

† Ebermayer, Phys. Chemie der Pflanzen, 1882, Bd. I., p. 404.

more or less completely the whole protoplasmic body of the cell. Often there is no contraction of the protoplasmic body, and the whole contents of the cell, excepting the thin primordial utricle closely applied to the cell-wall, are highly coloured (*e.g.*, leaf and cortical cells of *Prunus Laurocerasus*, *Ilex aquifolium*). Where oil drops are present, *e.g.*, in *Ilex aquifolium*, these, in such cases, show brightly through the yellow-brown mass.*

In the second case, where the cells contain large quantities of starch, as met with in the medullary rays of the wood, the cells of the pith-crown, many cells, isolated or in a reticulum, of the central pith, and the wood cells (where tannin is comparatively infrequent), the tannin, originally in solution in the cell-sap, becomes, as the latter is displaced by the accumulating starch grains, firstly more and more concentrated, penetrates often, as already noted, the starch grains themselves, and when treated with potassium bichromate commonly the whole mass of the cell-contents collects into one very dark brown ball, in which the starch grains are barely or not at all distinguishable; sometimes it forms an irregular brown granular-looking reticulum, in the meshes of which the starch grains can easily be seen.

Wigand is partially correct when he says that when a plant contains tannin and starch, the two are usually not only in the same tissues, but also in the same cells; but he is far from correct when he says that they are not, as a rule, present simultaneously.

On the other hand, in many cells, particularly in those which in spring have been emptied of their starch, but also in many cortical cells, particularly in the "exhausted" plants hereafter spoken of, the potassium bichromate does not form these clear masses with the tannin, but instead we get irregular collections of blackish brown disintegrated looking fragments or small lumps, especially collecting round the outer parts of the cell-lumen, leaving the centre quite free. This difference is probably significant.

* During life, probably, the protoplasm is not so freely permeable to tannin as is generally assumed. After death, and use of iron reagents, I have sometimes found the nucleus in tannin-containing cells, as well as in the neighbouring cells, beautifully stained from infiltration of tannin, *e.g.*, in the rhizome of *Botrychium lunaria*. By soaking sections of cellular tissue, free of protoplasm, *e.g.*, sections from a fallen leaf-stalk, in a solution of tannin, and then testing with iron salts, the cell-wall, too, is often well stained, a phenomenon which I have not noticed during life. This is probably the explanation of Hartig's, "Wandungszustand" of tannin in *Salisburia*.

In no case is there noticeable, as Wigand asserts, a diminution of tannin in early winter as starch accumulates. The explanation of his observations is probably to be found in the physically necessary concentration of the tannin in winter, owing to the space occupied in many of the cells by the starch accumulated there. There is no sign that the starch is formed at the expense of the tannin. On the other hand, in spring, with the consumption of starch in the processes of growth, I have not, with Wigand, noticed any marked increase in the tannin contents of cells in which it already existed, or increase in the number of those cells in any storage part. The filling of the cell with cell-sap restores the tannin, however, to a more dilute form, the quantity being possibly increased somewhat.

In the newly formed spring elongation of the axis, tannin makes its appearance in quantity dependent on the amount of growth. Were it a food material, one would expect it, like starch, to disappear from the older tissues. Of this, however, there is no sign. The tissues of the bud are often crowded* with it, usually, however, excepting the strings of procambium.

It will be seen from the above observations that, although I dispute the conclusions of Hartig and of Wigand, there is little or no constructive evidence to show that tannin is not a stage in the metabolism of the food materials, such for instance as an intermediate product between starch and glucose, and more or less closely allied to the latter. Evidence derived from chemical and microchemical reactions points to a close affinity between sugar and tannin. Experiments conducted, however, with the tannin of chemists are of no use in determining a physiological question such as this. Such tannin, I believe, always contains a certain amount of free glucose, and perhaps another proportion very loosely combined. The fact that some tannins can, by boiling with dilute acids or alkalis, be broken up into glucose and something else, is of chief interest as suggesting, as my own experience seems strongly to do, that the glucose reaction of Sachs† is not a pure test for glucose, when tannin also is present in the tissues. At the same time, Pfeffer's contention that tannin is not so broken up in the tissues, because the "something else" is so rarely found in the vegetable kingdom would, it appears to me, only be valid

* I do not here refer merely to the bud scales, in which tannin is in most cases exceedingly abundant.

† Sachs. Flora, 1862, p. 289.

on the assumption that this other product is not itself capable of immediate subsequent decomposition or recombination.

Leaving, therefore, the inherent capabilities of the tannins to be discussed by the chemists, I have proposed to myself the following :—

If tannin be a food material, then, like other food materials, it will, in case of need, be used as food.

This I have submitted to experimental evidence by three parallel series of investigations.

- (1) Plants, or portions of plants, which from previous investigation I knew to richly contain tannin, were allowed to grow under such conditions that assimilation was impossible.
- (2) Seeds were germinated in darkness, in order to see whether the tannin then formed was used up in further growth.
- (3) Corms were investigated, in order to see whether the tannin which they contained was transferred to the newly formed corm, with the transfer of the starch.

Potassium bichromate was used in all these investigations, and the preparations made at different times actually compared with one another. The following is a summary of the experimental evidence thus afforded :—

Corm of *Crocus*. May 28th.—The old corm contained starch throughout its tissue, but mostly in scattered “heaps” of grains, no cell being full, except near the part of union with the new corm, hereafter called the “union base.” Tannin is present in isolated cells, completely filling them with a large brown to very dark brown mass, especially abundant in the cells near the union base, less numerous as you get more remote from this. Many of the conducting cells of the vascular bundles are also full.

The young corm has its cells immensely crowded with starch, mostly in small grains. Treated fresh with iron-salt, it apparently has no tannin, but potassium bichromate shows isolated grains, less frequent than in the old corm, and in all cases contained in cells which contain starch. Near the union base it also is much more abundant. In the young corm the tannin does not fill the cell with one mass, excepting in many of the cells near the union base; but is in the form of several small, often irregular, globules or balls.

June 25th.—The old corm is shrivelled, and entirely free of starch. The distribution of tannin shows no change whatever. There is no apparent reduction in quantity. The

young corm shows increase in the quantity of tannin, though not to any marked extent. Its distribution is unchanged.

In the corm of *Crocus* the tannin is not, therefore, like starch, transferred from the part whose function is ended to that where its utility can be continued.

Similar evidence is given by *Arum maculatum*, and the bulb of *Narcissus Pseudo-narcissus*.

Æsculus Hippocastanum. April 13th.—Shows abundant tannin in the cortex of twigs in scattered cells. All cells of phellogen, and most of phelloderm full; a few of the bast ray cells full, as are many cells of the soft bast; a few cells of the wood rays; scattered cells in the pith-crown full, and some cells in central pith. In the leaf-traces of previous year's leaves, the whole of the parenchyma of the vascular bundle is full. The cells underlying the cork layer on the scar are full; none in the cork layer itself; but some of the cells of the parenchyma of the leaf-stalk, which still adhere outside the scar, contain tannin.

On this and the succeeding plants the method of investigation adopted was to enclose branches in dark frames, with provision for ventilation, and thus leave them to grow, but not to assimilate.

The experiments closed on July 21st. The tannin had undergone no diminution whatever in the stem of the last year, although the starch was quite exhausted. This year's stem, however, showed an almost complete absence of starch, but tannin perhaps more than in the normally grown stem of the year. The tissues of the bud and pith are especially full of it.

On *Pavia rubra* (smooth-fruited red-flowered horse chestnut), I experimented also with flowering axes. The flowering and fruiting proceeded apparently almost normally; but when the fruits were approaching half-an-inch in diameter, most indeed much sooner, they fell off. They, and all the tissues of the peduncle, this year's and last year's stems showed tannin, but no diminution in the last year's stem.

Similar evidence is given by *Quercus pedunculata*, of which, however, I could not quite exhaust the starch, *Pyrus Aucuparia*, and *Syringa vulgaris*.

I investigated also *Ilex aquifolium* and *Rhododendron* as types of the evergreen, but did not succeed in exhausting the supplies of starch, notwithstanding the free flowering and subsequent active growth of the latter species.

Pinus sylvestris (April 13th), in which plant Schell had seen the diminution of tannin in the spring, I carefully investigated. Last year's stem contains pretty abundant tannin in the outer cortex, and the cells around the resin

passages, moderately in the other cortical cells, considerable quantity in the bast, especially the outer bast, and a fair quantity in the pith. The young tissues of the bud have nearly every cell full; the bud scales are full.

For some time, about every week, I examined this stem; there was an undoubted diminution of the tannin; (1) in the bast, (2) in the cortex, (3) in the tissues succeeding from the bud; the bud itself remained full. Testing the stem with alkanet, showed that this decrease of tannin proceeded *pari passu*, with an increase in the amount of resin; the cells surrounding the resin ducts always showed the free presence of tannin.

According to Schell, starch and oil are wanting in the stem of *Pinus sylvestris*. This is not entirely the case. A few of the ray cells, both in wood and bast (on November 24th), contained starch in very small elongated grains. Some outer cells of the pith contained much larger grains, tending to kidney shape; many of the cells surrounding the resin passages of the wood (not of the cortex) also contain starch. On the other hand, most of the cells of the cortical tissue and bast contain a considerable amount of glucose, though this may be partly produced by the decomposition of the tannin in the reaction.

The tannin of *Pinus sylvestris* therefore may have relations with the copious resin formation of spring, but not with the building of new tissues.

I have not investigated *Larix europæa*, where Schell also says tannin is used as food material.

The rhizomes of *Scolopendrium vulgare* and of *Nephrodium* sp. showed (April 21st) abundant tannin in the starch parenchyma, as well as in the parenchyma of the vascular bundles; with further development this does not disappear or diminish, but seems rather to increase.

Fuchsia (hardy out-door) showed, May 30th, its root stock and young stems alike with abundant tannin. Made to grow in the dark, its tannin showed no signs of diminution, even when the starch was quite exhausted, and the plant gradually died from exhaustion.

Young plants of *Fuchsia* grown in a stove, and forced to grow in the dark from May 28th till complete exhaustion (with various specimens from June 28th to July 17th) showed no apparent diminution in the tannin contents.

Digitalis purpurea also, grown under a dark shade from May 23rd to June 19th, showed no diminution in the tannin present or once formed, whether in its root-stock, or in its stem (in which the tannin is mostly found in the angles of

the stem decurrent from the leaves). In the root-stock, however, which is very rich in (with potassium bichromate) clusters of minute globules, these globules amalgamated and altered their arrangement in such a way as at first to give the impression that the tannin had considerably diminished.

(To be continued.)

F U N G U S E A T I N G .*

BY W. B. GROVE, B.A.

The test of an educated Englishman is his readiness to eat a well-cooked toad-stool. Observe, his "readiness" to eat, not his eating—and note also the "well-cooked." This apparent paradox is, after all, but a special instance of the self-evident theorem that superstition varies inversely as education.

To recommend to a rustic, who has reached the ordinary high-water mark of agricultural instruction, that he should use a little of that vast store of food which rots at his very doors, is to call forth a stare of contemptuous amazement, or a smile of superior disdain. *Omne ignotum pro horrifico*. "What! eat them pisonous things! It's flyin' in the face of natur'," who created toad-stools, forsooth, merely to be kicked.

A few countrymen have heard tell that "furriners" do not despise such food; but then "furriners" devour all sorts of nasty things. In one or two parts of the Midland Counties, certain of these rural persons have actually dared to eat something other than the common mushroom. Its near ally, the Horse-Mushroom, is dignified in the northern part of Warwickshire, and perhaps elsewhere, under the title of the Champignon; and is eaten by the Agamemnons and Hectors of the district, probably with secret trembling, but with a heroism worthy of another epic. The Champignon of cryptogamic botanists is, of course, a widely different species; but, as these village wiseacres knew of only two names for edible fungi, and the mushroom had already appropriated the one, they had naturally no resource but to apply the term Champignon to the other. The two species are, however, so much alike, that the rustic eye probably differentiates the Horse-Mushroom merely by its greater size. A mushroom rarely exceeds five inches in diameter, while the Champignon may reach twelve or more; the latter never has the bright

* "An Elementary Text Book of British Fungi." Illustrated. By W. D. Hay. London: Swan, Sonnenschein, Lowrey and Co. 1887.

salmon-pink gills of the former and its gills are browner at maturity, while its flesh is thicker and more substantial. In flavour they are similar, but not the same; one who has tried them both can readily distinguish them by that alone.

The richer sort are also fungus-eaters, in a similar pettifogging way. Truffles and Morells, bought at a fancy price from the Italian warehouseman, are fit to set before a prince, but those which his servants might gather from his own fields and parks he must never dare to touch. The inanity, the stupid malignancy of the distinction which thus elevates one particular species of fungus on a saintly pedestal above the rest, and saith: "This shalt thou eat and none other," would be a puzzle hard of explanation, if we did not know that the average British mind is intensely superstitious, while it thinks itself intensely practical. The guilt lies mainly on the shoulders of the man who first bestowed on fungi the nickname, "Toad-stools." Give a dog a bad name, and you know the consequences. The toad has an evil reputation.

Some people are fond of saying that toad-stools have a poisonous look. The main idea of this statement, so far as it has any idea at all, seems to be that bright colours are intended as a warning—"Touch-me-not." How little truth there is in the notion every fungus-eater knows, for those who hold it place the luscious Chantarelle, and the Delicious Lactare, under the same ban as the deadly Fly Agaric. What can be nicer and more enticing than the pure white flesh of a well-grown Giant Puffball; yet our country clod-hoppers can find no better use for these pounds of vegetable sweet-bread, than to throw them at one another's heads.

The question of fungus eating is usually regarded as a fad of no more importance than as it furnishes an amusement to a few harmless enthusiasts. But this is not so. There have been circumstances, and may be again, in which it would be of national importance. In the great Irish famine, thousands of ignorant peasants starved, while tons of nutritious dainties covered the land around their cabins. Potatoes and butter-milk, even when plentiful, are not such delicacies that those who are compelled to live on them should neglect the relish which lies so ready to their hands.

Among the most recent attempts which have been made to extend the eating of fungi is the book which forms the subject of this notice. The author possesses certain qualifications for his task, which, if they had been rightly used, would have produced an admirable result. His knowledge of the esculent species, judging by his own account, is more

extensive than perhaps any other Englishman could boast; and moreover there seems to be no reason to suppose that he has much exaggerated this knowledge. At any rate, he mostly tells you, at first hand, what has been his own experience, and thus his work differs from many writings that have previously appeared, which merely tell us over again what we can find in other books.

Another advantage which the writer possesses, is that he evidently does not belong to the clique which rules the mycological roast—or rather, stew—in this country. As he says: “It has never been my privilege, as yet, to meet with any person versed in mycology, from whom I could derive instruction.” There is thus a freshness and a breezy originality about what he writes, which is both interesting and bracing. He exhibits a disregard of the common prejudices of mycologists which is almost sublime. His passion for alphabetical arrangement, for instance, leads him to mix up unallied species in the fashion which popular writers usually, but erroneously, imagine to be more suitable for their audience.

Mr. Hay’s great desire is to popularise the eating of fungi, although the title of his book is so worded as to give no hint of his design. For this purpose he describes, in language which he tries hard to render simple, all the British fungi which can by any stretch of imagination be considered esculent, together with some which are not British, and some which, even if they be considered eatable, offer scarcely anything tangible to eat. The latter he prettily names “Jelly-sprouts.” Then, *per contra*, comes a list of the chief poisonous species, so that, if the searcher after novelties should find himself suddenly taken ill, he may know what name to apply to the author of the mischief.

Two of the most important parts of the book are chapter vii., where notes are given “On some common species of eatable mushrooms,” and Appendix B, “Culinary Receipts,” in which 133 methods of cooking the various kinds are enumerated. Besides these there are Notes on Mushrooms dedicated to Saints (half the information in which is false), an Index (carefully arranged so that nobody can by any exercise of ingenuity find the species he is in quest of), chapters on the Discrimination of Fungi, their Use, Anatomy, Classification, Chemistry and Toxicology, Cultivation, &c., &c., and finally, at the end of the work, sixty-four plates of all possible kinds of fungi, eatable and uneatable, only eight or ten of which have even the slightest connection with the subject matter of the book.

It is evident from this that there is much to commend, but also much to criticise in the result of Mr. Hay's endeavours. Perhaps his greatest fault is his deficient sense of the ludicrous, which suggests for him a Scotch descent. In regard to the plates, *e.g.*, which are the most objectionable of all the blunders, he is careful to make the publishers responsible for the stupidity of including in a work dealing with *eatable* fungi, a series of plates representing microscopic species, many of which are totally invisible to the naked eye. The publishers' apparent desire was to make the book look larger and more imposing at a cheap cost, and for this purpose they dragged in, regardless of their impertinence, all the old figures formerly used to illustrate Cooke's Handbook. But the author ought to have foreseen the ridicule which such a proceeding would call down upon him, and have made a stand against the spoiling of his work.

The want of a feeling for the ludicrous is still more plainly visible in the English names he invents for the heading of his descriptions. It might be well to have English names by which to designate the eatable and poisonous kinds; but certainly no one, outside a company of the insane, could use those which the author has invented without exciting Homeric laughter.

Picture to yourself the funeral procession on its way to the cemetery of Big St. George, the Arch-Bane, seated on Beelzebub's Cushion, at its head; the Golden Spindle-spike for the beadle, the Crocodile for chief mourner, the Guilty-sprout for the corpse, the Sickener as the medical man, the Black Bulgar as the "intelligent foreigner," the Longshank and the Spotty-leg Bolet as the mutes, the Chamæleon and the Yellow Reptile to draw the hearse, the Wrinkle-twigg to form the plumes, and the Turn-over to dig the grave. With what conscience could you invite your friends to a dainty dish of Rat's-paws, or Red-nails, or Blood-stains, or Peg-tops, or Little Darkies, all of which are put forth as edible; the latter suggests cannibal propensities. The titles of some of the culinary receipts are just as laughable; it does not sound like a cook's duty "To prepare Parasols," or "To pickle Spindle-shanks," while when the author shows us how "To prepare Urchins," he surely trespasses upon the governess's domain. "Urchin Ragoût" has an uncanny sound; and most fungus-eaters, who, as becomes a naturalist, are usually somewhat bashful men, might shrink from being introduced to such sirens as the Grisette, the Ingénue, the Blusher, the Brazen-face, or the Sickener's Sister.

The total number of esculent species enumerated is 221 ; but some of these are such as few people would care to tackle. Yet I have myself eaten two of the most unlikely, *Polyporus squamosus* (young, of course), and *Lactarius turpis*, and though it must be confessed they are not nice enough to tempt a dying anchorite to eat, yet they form a respectable alternative to starvation. Many of the species mentioned are also rare ; but still one can eat them when they are met with, and therefore it is as well to include them. The number of poisonous species is only fifty-three, so that the chances against one's being poisoned may be reckoned about four to one. Of course the vast mass of fungi are such as either offer nothing to eat or, if eaten, exert no active influence whether harmful or the reverse.

The enquirer who takes this book as his guide will find a great many of his fungophobic superstitions disappear before the author's treatment of his subject. It is not many evenings since, in the centre of Birmingham, two little parties of five and four sat down to a fungus supper, the courses of which consisted entirely of toad-stools, cooked according to the recipes there given. Those who partook of them are still alive, and anxious to repeat the experiment. If only Mr. Hay would strike out those false or redundant parts in which he travels beyond his knowledge, such as his random etymology and the note on p. 43, which is exactly sixteen years behind the times, and would confine his remarks to that which he has actually himself investigated, this book, rebaptised and reduced to about half its size, would then become an essential element in the library of every fungus-eater.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 288.)

“Stourbridge and its Vicinity,” by William Scott, has been previously referred to in these pages. It was published in 1832. The introductory remarks to the Botanical Chapter will be found at p. 539 ; they are followed, at p. 540, by “a select descriptive Botanical Catalogue.” Many of the species enumerated therein are stated by the author to have been “honoured by an insertion in the ‘Midland Flora.’”

This Catalogue is at once one of the most interesting and one of the most provoking contributions to the history of Worcestershire Botany. It has preserved to us a record of the rarer Flora of Cradley Park, woodland in Scott's time, soon after stocked and converted into arable, and subsequently changed into collieries and brickworks. It records also other plants of the Stourbridge district, now extinct. On the other hand, it has many defects. Stourbridge is in the County of Worcester, very near the Stafford boundary. In many cases the exact localities are not given, and it is impossible to tell whether the plants named were found in Worcester or Stafford.

For instance, several rarities are recorded from "*Iverley*," a district on the high road from Stourbridge to Kidderminster, situated on both sides the county boundary, without any notice whether the plants were found in Worcester or Stafford. In other cases the specific names are omitted, or the names quoted in such a manner as to make it impossible to tell what plants were intended. Finally, there are so many obvious errors of identification as to throw more or less discredit on the entire list. Under these circumstances I have introduced a new sign (§) to indicate plants which may not be misnamed, but which cannot be certainly claimed as Worcester records. I have given Scott credit for most of the common plants inserted without locality, omitting a few recorded by previous authors.

William Scott. "*Stourbridge and its Vicinity*." 1832. A select descriptive Botanical Catalogue, p. 540.

* *Ranunculus parviflorus*. Lanes near Hagley.

* *Nymphæa* (*Nuphar*) *lutea*. Blakedown; Broadwaters, near Kidderminster.

* *Fumaria* (*Corydalis*) *claviculata*. Dingle near Lye.

F. capreolata. Dingle near Lye.

* *Cardamine impatiens*. Double blossomed. Field near the Spout, Hagley. Noticed by Withering.

An error for C. pratensis. (See Withering, 4th Edition, p. 568.)

* *Turritis glabra*. Hagley; Wollaston; Bridgnorth Road.

Cochlearia Coronopus. (*Senebiera Coronopus*. Poir.) Heath Road side.

† *Viola Hottonia*. Marshes. No locality.

The plant probably intended is Hottonia palustris, L., not now known near Stourbridge. It is strange that the locality should not have been specified. It grew on Birmingham Heath in Withering's time. (See Stokes's Withering, p. 954.)

V. odorata. Blue, purple, white. Common.

† **V. parviflora** of Dr. Stokes, *clandestina* of Hortus Croomensis.
Iverley Hill, summit of sandpit, Pedmore part of the Hill.

*The identity of this plant is too uncertain to assign
any modern name to it.*

V. canina. (*V. sylvatica.* Fries.) Woods about Cradley, &c.

* **V. tricolor.** Cornfields.

*This I take to be the form V. arvensis, Murr. The
type has previously been recorded.*

* **Drosera rotundifolia.** Pedmore Common; banks of Harborough
Pool.

† **Dianthus cæsius.** Blackstone Rocks near Bewdley.

An error for Dianthus deltoides.

* **Saponaria (officinalis).** Banks of Stour near Lye Mill.

† **Silene conica.** One field, Iverley. Now extinct.

Query in which county and whether really this species?

* **Hypericum Androsæmum.** Lutley Holloway.

* **H. humifusum.** Sandy fields.

* **Radiola millegrana.** (*R. linoides.* Gm.) Banks of Harborough Pools;
Pedmore Common.

Linum catharticum.

* **Geranium phæum.** Cradley Park.

* **G. lucidum.** Halesowen Hill.

G. Robertianum, album. Lutley.

* **Erodium moschatum.** Sandy fields.

Euonymus (europæus.) Hedges near to the Lye, and Hagley.

Ulex europæus. West of Iverley Hill.

* **U. nanus.** East of Iverley Hill, and various commons.

Doubtless U. Gallii, Planch.

† **Genista spinosa.** Whittington Common, *Stafford.* Plentiful, but
observed nowhere else.

This is G. anglica. (See Purton, 333.)

G. tinctoria. Coalpit banks in various directions. (*Some probably in
Worcester.*)

* **Anthyllis Vulneraria.** Banks of Dudley Canal between Haywood
and Lappal only.

Ononis alba. Haseler, near Evesham. Very rare. Purple, common.

This may be accepted as a record for Ononis arvensis.

* **Trifolium arvense.** Sandy grounds.

T. fragiferum. Hagley. Rare.

Not seen at Hagley in recent years.

* **Comarum palustre.** Morass. near Pedmore Common.

- Rubus Idæus. Woods and marshes.
- * Rosa spinosissima. Blakedown Holloway.
- * Peplis Portula. Pedmore Common.
- * Circeæ lutetiana. Foxcote, Oldenhall, and many other places.
- * Sedum Telephium. Lickey Hills.
- * Cotyledon Umbilicus. Near Clent Church.
Not now known in this locality.
- * Saxifraga granulata. Hagley, Churchill.
- * Chrysosplenium oppositifolium. Cradley Park, Harborough, Lutley, various morasses, banks of Stour and other streams.
- * Hydrocotyle vulgaris. Harborough and Pedmore Common.
- Sanicula europæa. Cradley and other woods.
- Cornus (sanguinea). Hedges near the Lye, Love Lane, Hanbury Hill.
- * Adoxa Moschatellina. Foxcote, Holloways at Oldenhall, and between Broughton and Drayton.
- Sambucus Ebulus. Overend, Cradley.
- Viburnum Opulus. Cradley Park.
- * Galium saxatile. Heaths, &c.
- G. Aparine. Marshes.
- G. Witheringii. *No locality.*
Var. of G. palustre.
- Sherardia arvensis. Corn and grass fields.
- * Dipsacus pilosus. Banks of Stour, near Stourbridge, on the road to Halesowen; Lye Mill.
- Serratula tinctoria. Banks of rivers and canals.
- Centaurea Scabiosa, greater Knapweed. Cornfields.
- C. nigra, lesser. Cornfields.
- † C. Jacea, radiated. Cradley Park.
An error. Probably C. nigra, with radiant heads.
- † Artemisia Absinthium. *No locality.*
- Bidens cernua. Banks of streams.
- * Conyza squarrosa. Vicinity of Hagley.
- * Solidago Virg-aurea. Coppices, Cradley, and Stamber Mill.
- Campanula glomerata. Dudley Castle Hill.
- * C. latifolia. Lutley Holloway.
- * C. patula. Cradley Park, vicinity of Broughton, Churchill, &c.
- * Vaccinium Myrtillus. Cradley Park, Pedmore and other Commons, Bilberry Hills, Lickey.
- * V. Oxycoccus. Pedmore Common.
- * Erica (Calluna) vulgaris, alba.
- E. cinerea, alba.
- * E. tetralix, alba.
- All very rare; purple, common.

† *E. ciliaria*. Once growing in a morass near Round Hill, Iwerley.

I suppose intended for E. ciliaris; must be an error.

Pyrola media. Cradley Park. Very rare. The only plant, transplanted, cultivated, and soon lost, 1817.

* *Vinca major*. Broughton near the bridge, Iwerley Hill, and Holloway leading to Churchill.

* *Chlora perfoliata*. Fields near Wychbury Hill, Cradley Park.

* *Menyanthes trifoliata*. Blakedown and Harborough.

* *Solanum nigrum*. Hagley Lanes; Wolverley.

* *Atropa Belladonna*. Dudley Castle Hill.

The "Bell's Mill" locality communicated to Purton is not recorded.

* *Hyoscyamus niger*. Hagley and Broom Lanes. Become very scarce.

* *Verbascum Thapsus*. Commons.

* *V. Blattaria*. Commons.

V. Lychnitis. Hagley.

This is the first record of V. Lychnitis as a Worcester plant. It does not now grow at Hagley.

* *V. nigrum*. Hagley; Broom.

* *V. virgatum*. Iwerley. Rare.

* *Limosella aquatica*. Pools near the Heath.

* *Melampyrum pratense*. Cradley Woods.

* *Verbena officinalis*. Drayton in Chaddesley.

Thymus (Calamintha) Acinos. Churchill Field corner.

* *Scutellaria (galericulata)*. Banks of streams and canals.

Melittis grandiflora (var. of *M. Melissophyllum*). Woods and fields near Halesowen.

Marrubium vulgare. Iwerley. Baldwin's Green near Lye Waste.

* *Leonurus Cardiaca*. Iwerley Hills and adjoining fields.

Ajuga reptans. White. Wollaston Rocks.

Query in which county?

* *Symphytum officinale*. Banks of streams; morasses.

* *Cynoglossum officinale*. } Brettel Lane; canal banks; roads near

† * *C. sylvaticum*. } Hagley, &c.

Cynoglossum sylvaticum must, I think, be an error.

* *Lysimachia nemorum*. Woods. Cradley.

L. Nummularia. Cradley Park, Hodge Hill, Wychbury Hill.

Anagallis arvensis (no locality). "In addition to the scarlet a blue variety is found on Bredon Hill."

This is the first record of the common form. The blue var. is noticed by Nash.

* *Plantago media*. Pedmore Rocks.

* *P. Coronopus*. Commons.

† *P. maritima*. "Flourishes at Stourbridge." (See foot note in Scott, p. 553.)

Surely this must be an error.

† *Rumex aquaticus*. Banks of Stour, &c.

Probably an error for R. Hydrolapathum.

Polygonum Persicaria.

* *P. Hydropiper*.

P. Fagopyrum.

* *Daphne Laureola*. Woods. Witley, &c.

Parietaria (officinalis, L.) Chaddesley.

Humulus (Lupulus). Casually occurring in hedges.

† *Populus communis*. Banks of Stour.

What can this mean?

P. alba. Banks of Stour.

P. tremula. Harborough.

P. nigra. Near the Hayes on Banks of Stour.

Typha latifolia. Harborough, various pools.

Sparganium ramosum. Very common in morasses.

S. simplex. Very common in morasses.

* *Sagittaria sagittifolia*. Banks of Dudley Canal near Lappal Tunnel only.

Alisma Plantago. Ponds.

* † *Butomus umbellatus*. Different levels of canal near Moor Lane, in the water. Query county?

Orchis maculata. Woods and meadows.

* *Orchis*, handed. Cradley Park. Very rare.

This must be Gymnadenia conopsea. (See Purton, p. 422.)

† *Ophrys*. Wychbury Wood, Cradley Park and fields.

Query what species?

* *Serapias grandiflora*. Woods near Lea Castle, Wolverley.

Cephalanthera grandiflora, Bab.

† * *Satyrrium viride*. No locality.

Habenaria viridis. R. Br.

† *Satyrrium albidum*. Cradley Park, Wychbury Wood, Hodge Hill, Blakeshall.

Gymnadenia albida Rich. Certainly an error; perhaps *Habenaria bifolia* was mistaken for it.

- * *Narcissus Pseudo-narcissus*. Overend, Cradley.
N. biflorus. Glasshampton, Worc.
Tamus communis. Hedges.
- * *Paris quadrifolia*. Wychbury Wood, Cradley Park.
Juncus (Luzula) campestris. Meadows.
J. bufonius.
J. effusus.
J. conglomeratus.
- * *J. squarrosus*.
- * *J. uliginosus*. Morasses, banks of streams and other humid sites.
(J. supinus, Mœnch.)
(To be continued.)

MR. HERBERT SPENCER.—The numerous friends and admirers of the distinguished philosopher will be interested to hear that he has recently left Brighton, where he has been living for nearly two years, and taken apartments at Bournemouth, and that the change has already been of considerable benefit to his health.

LOCAL BIRDS.—It will interest students of ornithology to know that the following birds were recently shot within a few miles of Birmingham, during one half-day's collecting:—Temminck's stint, *Tringa Temminckii*; little stint, *T. minuta*; dunlin, *T. alpina*; curlew sandpiper, *T. striola*; ringed plover, *Charadrius hiaticula*; red shank, *Totanus calidris*; common tern, *Sterna fluviatilis*; black tern, *S. fissipes*.—J. BETTERIDGE.

Reviews.

A Manual of the British Discomycetes, with Illustrations. W. PHILLIPS, F.L.S.—London: Kegan Paul, Trench and Co.

THIS, the sixty-first volume of the International Scientific Series, is another instalment of the work which is being slowly done towards placing the British mycologist in the same position with regard to the present state of that science, which the publication of the "Hand-book of British Fungi" enabled him to assume sixteen years ago. The "Hymenomycetes Britannici," already noticed in these pages, worthily led the way, and of the present volume it would be sufficient praise to say that it does the same with respect to the group of which it treats, that was done for the higher fungi in the Rev. John Stevenson's two charming volumes. But more, far more than this, can be said. The "Hymenomycetes" was, in part, confessedly a compilation, founded on the last work of the immortal Fries—a clever and useful compilation, it is true, irradiated throughout by the touches of one who knew his subject. But here we are in the presence of a

master hand, one which is personally familiar with all the details of which it treats, and the consequence is a fulness of knowledge, and an all-pervading clearness which are the more enchanting, the more bewildering the chaos which they have put to flight. The typographical arrangement leaves little to be desired. I have several times taken occasion to urge the importance of this consideration; a little more space devoted to the summaries of genera and species, a little more recourse to the various kinds of type, make an enormous difference in the comfort and convenience of those who use the book. Works published on the Continent are often sadly wanting in this respect; even when the subdivisions have been made, the headings are so carefully hidden away in the mass of type, that it takes almost as long to discover them as it would to make the subdivisions oneself. One thing is, perhaps, to be regretted: the lists of localities given are in some cases so meagre as to be misleading, since they convey the impression that some of the species are much less widely distributed than they really are. But no lists of localities, however complete, could of course remain so beyond the moment of publication. The recent discovery of the almost unique *Boudiera areolata* by Mr. J. W. Oliver, in the immediate neighbourhood of this town, is but a specimen of what is always going on. It now remains but to add that the seventy-nine figures given at the end are marvels of minute and accurate detail, to show that this is a book of which Mr. Phillips and his publishers may well be proud.

W. B. G.

The Geology of England and Wales; with Notes on the Physical Features of the Country. By HORACE B. WOODWARD, F.G.S., of the Geological Survey. Second edition, 8vo., 670 pp., 101 woodcuts, and coloured map. London: G. Philip and Son, 32, Fleet Street; price 18s.

THIS work can only be described as an encyclopædia of English geology. And yet it is far more than an encyclopædia, for the enormous collection of facts is marshalled in so orderly and well-arranged a manner that it reveals the geological history of our country in a far more truthful way than any "history of kings and peoples" that has ever been written.

The frontispiece is a capital autotype reproduction of a photograph of the well-known red-chalk cliff of Hunstanton; and at the other end of the book there is an admirable index, extending over no fewer than 45 pages. Another feature of the book is the excellent "Synopsis of the Animal Kingdom, with especial reference to the Fossil Forms," drawn up by Mr. E. T. Newton, the well-known palæontologist.

In the body of the book, by the use of two sizes of type, an enormous number of facts are included. Each geological formation is discussed separately, its range across the country minutely pointed out, its fossils, rocks, and ores described; while in foot-notes references are given to the original authorities cited.

The first edition of Mr. Woodward's book—published ten years ago—obtained a wide and well-merited circulation; but this second

edition is practically a new book. It must have cost the author an immense amount of labour, but he may find comfort in the fact that his work will—must—find a place in every library, and upon the shelves of every geologist.

W. J. H.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—MICROSCOPICAL SECTION, November 1st. Prof. W. Hillhouse, M.A., in the chair; the subject being "Photo-micrography," with practical illustrations, by Mr. John Edmonds, who, after mentioning that too much had been made of optical difficulties arising from the non-coincidence of the visual and actinic foci of micro-objectives, and also of the apparatus required, and explaining the necessity for and method of obtaining adequate and equal illumination of the object, proceeded to state that his principal purpose was to show how photo-micrographs could be taken at night with the minimum of apparatus, by projecting the image of the object upon a sensitive plate, having first focussed it either upon an opaque screen formed of a plate of opal glass having a dead surface produced by grinding with fine emery powder, or upon a transparent glass plate, subject to the same process—according to the nature of the object and the amount of amplification required—the only other apparatus being an Argand petroleum lamp, with a metal chimney, emitting light only from a circular opening in front; a bull's eye condenser; the stand of a microscope (the body and eye-piece having been removed); and the objective. The room having been darkened, the lecturer projected upon the ground glass an image of a mounted *Aphrophora spumaria* (cuckoo spit), he then removed the ground screen, and substituted the sensitive gelatine dry plate of the kind known as "Ilford ordinary," quarter-plate size, and after an exposure of twenty seconds, developed, fixed, and washed the negative, and placing it in the lantern, exhibited an enlarged picture of the insect to the audience. The lecturer then showed several photographs of insects, entomostraca, vegetable sections, polycistina, &c., taken in the manner described, with objectives ranging from four inches to one-sixth inch focus. Messrs. T. H. Waller and C. Pumphrey took part in the discussion which followed, and Mr. F. J. Cullis spoke in commendation of the process and the manner of its exposition.—GENERAL MEETING, November 29th. Prof. W. Hillhouse, M.A., exhibited mustard seeds, germinated on a dry surface but in moist air, showing finely developed roots in the air, with an abundant root-hair system. A potato, which had germinated without light but in two stages, producing, in the first year, slender elongated tubers, resembling in form the pseudo-bulbs of many orchids, these latter, in the following season, giving rise to the long slender stems familiar to us in "sprouting" potatoes. Also, another potato, germinated in absolute darkness, which had given rise to a network of slender stems, bearing minute rounded tubers at the ends of short branchlets. Mr. Chas. Pumphrey exhibited an ironstone nodule with a clay core, from the drift at King's Norton, which bore a striking resemblance to an animal's tusk, six inches long.—MICROSCOPICAL SECTION, December 6th. Prof. W. Hillhouse, M.A., exhibited specimens of *Eucalyptus globulus*, showing the different forms of the leaves in different stages of its growth. He also explained the benefits arising from its antiseptic properties. Mr. J. E. Bagnall, A.L.S., exhibited,

for Mr. F. Enock, *Cyathus vernicosus*, the "bird's-nest" fungus, from near London. Mr. W. B. Grove, B.A., exhibited *Phycomyces nitens* (*Mucor Phycomyces*), growing on bread-and-butter; this mucor is the finest species of the group. Mr. W. P. Marshall, M.I.C.E., exhibited his new $\frac{1}{25}$ inch objective, and showed some interesting diatom tests, &c.—BIOLOGICAL SECTION, December 13th. Mr. J. Levick in the chair. A fine specimen was exhibited by Mr. W. B. Grove of *Mucor phycomyces*, a giant mould, growing, with stems four inches high, and said to grow to a height of nearly a foot. Mr. W. R. Hughes read a paper upon *Hyalonema lusitanicum*, the glass-rope sponge, illustrated by a number of diagrams and of very interesting specimens under microscopes, including *Hyalonema lusitanicum*, *H. Sieboldii*, *Grantia nivea*, and *Euplectella aspergillum*.—SOCIOLOGICAL SECTION. At a supplementary Meeting on Thursday, December 1st, Mr. W. R. Hughes, F.L.S., in the chair, a paper was read by Miss Dalton on Mr. Herbert Spencer's essay on "The Philosophy of Style." At a second supplementary Meeting on Thursday, December 15th, a paper was read by Mr. W. K. Parkes, on the first portion of Mr. Spencer's essay on "The Genesis of Science." On Saturday, December 17th, the tenth excursion of the Section was made to "Dr. Priestley's Country." The party drove to the principal places in Birmingham connected with the career of this celebrated father of modern chemistry; they afterwards took tea in the Society's Room, at Mason College, where a collection of Priestley books, pamphlets, engravings, and autograph letters was exhibited, and an address on the career of Dr. Priestley was delivered by the Rev. Dr. Crosskey.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—November 14th. Mr. H. Hawkes exhibited *Diderma globosum*, on holly leaf, a fungus, at one time supposed to be a low form of animal life; also a form of slide suitable for soirées, on which groups of similar objects can be mounted. The slide was a disc with a number of objects mounted near the outer edge. When the slide was revolved by the finger, the various objects appeared in succession.—November 21st. A paper was read by Mr. Delicate on "Trees." The writer dealt with the subject under three heads: their structure, products, and portraiture, and concluded by drawing a parallel between trees and animals. The paper was illustrated by a large number of photographs of trees, foliage, and fruit, exhibited by lime light, by Mr. O. Hutchinson.—November 28th. Mr. W. H. Bath exhibited pupæ and cocoons of British lepidoptera, including specimens of swallow-tail butterfly, currant clearwing, puss moth, death's head hawk moth, etc.; Mr. Bennet, a number of fossils from a gravel pit at Harrington.—December 5th. A Conchological night. Mr. J. Madison showed a large collection of specimens of *Limnaea stagnalis*, British, foreign, and fossil, and a number of specimens taken from one pond at intervals during the last thirteen years, showing marked variations; also specimens of *Helix pomatia*, just hatched, and of one and two years' growth.—December 12th. Mr. P. T. Deakin exhibited the tongue bones of woodpecker, *Picus minor*; Mr. J. Madison, an abnormal growth in the shell of *Planorbis corneus*, the outer whorl covering the next whorl; Mr. Corbet, specimens of *Calamites cannaeformis*, *C. Luckowii*, and *C. approximata*, from Bradley. Under the microscopes Mr. Hawkes showed a circular slide of twelve wings of lepidoptera; Mr. J. Collins, spiral tissue in yew, and Mr. T. H. Waller, a section of a pebble of Tourmaline schist from King's Heath, showing two faults in the space of an inch.

NOTES ON THE WARWICKSHIRE STOUR VALLEY AND ITS FLORA.

BY JAMES E. BAGNALL, A.L.S.

My interest in this district has been greater than in any other Warwickshire district, and this interest was first excited by my much respected friend, the late Rev. W. W. Newbould. Previous to his work nothing appears to have been done in this district, and, so far as I can find out, only one record exists, that of *Carduus acaulis*, Long Compton, given in Perry's List of Plants, contributed to the abridged edition of "Dugdale's Warwickshire," and published in 1817.

For two seasons, 1880-81, Mr. Newbould worked with evident diligence that portion of the Stour Valley adjacent to Honington, where he was residing temporarily, and officiating as vicar-in-charge of Honington Church. His researches were extended to all the district within a short radius of Honington, including Halford, Whatcote, Burmington, Ilmington, an occasional visit to Brailes, all in Warwickshire; and the neighbouring Worcestershire portions of the district, Shipston-on-Stour, Tredington, Willington, and Blackwell. All his notes and observations were carefully recorded in a manuscript volume, and the commonest weed was as carefully recorded as the more rare plant, with frequent interesting notes. In this same volume were also botanical notes on Warwickshire as a whole, culled from various printed sources, from Ray downwards, and from the various Herbaria existing at Kew, Kensington, and Cambridge. This volume, which is an epitome of industrious research, was very kindly placed in my hands by its author, and from this I gathered all my first notes from the Warwickshire Stour Valley, and much help for other portions of the county.

August, the 28th, 1880, by invitation from Mr. Newbould, I paid a visit to Honington. Mr. Newbould met me at Stratford-on-Avon railway station, and by the kind permission of F. Townsend, Esq., one of his carriages conveyed us the pleasant drive of ten miles to Honington. It was the most enjoyable ride I have ever taken, the day being fine, and my companion so truly congenial, so full of enthusiasm, with such a vast fund of anecdote or quotation from this or that famous

botanist past and present. Now and again the roadside banks became too attractive to allow us to pass them by, and then we walked and dallied and compared notes; ultimately we reached Honington, where, with thoughtful kindness, I found a second breakfast awaiting me. After that we had a good turn through the woods and pastures about Honington Hall for about four hours, and then returned through the pretty Worcestershire village of Tredington to dinner—and all the time we seemed in a sort of charmed land. Everything about me appeared to have fresh interest, for upon even the more common plants my companion had something to say, or something to tell me which Mr. Borrer, or Dr. Boswell, or Mr. Baker, or some other notable botanist had said; so that the time literally fled. But we were not idle talkers merely, for though the season was far advanced, and the ground covered of small extent, my companion had so well explored the district that I found by the entries in my note book we had observed in fruit or flower about 234 species. Part of our conversation was on the Flora of Warwickshire and the form it should take, and it was owing to this conversation that I decided upon rewriting the whole matter, and taking the water partings of the river basins as the basis of my districts, these being, in Mr. Newbould's estimation, the more natural botanical districts.

Mr. Newbould's work in this district was, as I have said, the first of which I had any record; altogether he recorded about 420 flowering plants and ferns. Included in this were some MS. notes (which he had copied from an old Flora) made by the Rev. James Gorle, vicar of Whatcote, and were most of them from Whatcote, Idlicote, or Halford.

These notes of Mr. Newbould's have also been supplemented by others kindly sent to me by F. Townsend, Esq. After Mr. Newbould's death, feeling a desire to finish as far as circumstances would allow a work so ably begun, I gave a portion of my leisure time of 1886-7 to this district, and, although my present record exceeds my own expectations, I am convinced that much still remains to be done. The district is very difficult of access, the nearest railway station at the southern extremity being Moreton-in-Marsh, which is two miles from the Warwickshire border, has an inconvenient service of trains, and is a journey of from three to four hours' duration. The stations on the northern border are Ettington and Kineton, both of them being very awkward as regards the service of trains. No line of railway or canal penetrates any portion of the district, a tramway running from Stratford to Moreton-in-Marsh is used for goods only, and seems little

used. So that to work this district long walks have to be taken, and thus much time is lost in getting from one part of the district to another.

POSITION OF THE DISTRICT AND BOUNDARIES.

The Stour Valley lies south-west of the Edge Hills and north of Bright Hill, a narrow tongue of it running north of Ilmington to a few miles S.W. of Stratford-on-Avon. Its geographical position is $51^{\circ} 58' 20''$ to $52^{\circ} 9' 50''$ north latitude, and $1^{\circ} 44' 5''$ to $1^{\circ} 50' 0''$ west longitude. It is bounded on the south by the high road running over Bright Hill to Chipping Campden—this includes some of the outlying portions of Worcester and Gloucestershires; on the west by the elevated land about Ilmington, Preston-on-Stour, Atherstone-on-Stour, and a line from the latter village to the Avon, just below Milecote; on the north partly by the Shipston Road from Stratford-on-Avon, to near Upthorpe Bridge, thence by the lane to Upper Easington, and from this point by the high road from Easington to the high road to Lower Tysoe; on the east by Tysoe Hill and the highway from Over Tysoe, over Traitors' Ford to Bright Hill. The total length of the district is about $17\frac{1}{2}$ miles; its breadth in the widest part about $10\frac{1}{2}$ miles. This, however, includes a portion of Worcester and Gloucestershires, which has not been included in my notes. The acreage of the Warwickshire portion of the district is some 46,000 acres.

ELEVATIONS.

The Stour Valley is surrounded on all sides by hills and elevated land, but the elevations are in no instance sufficiently great to influence the flora. Taking our stand upon the southern boundary of the district, Bright Hill, we may from this point get a more general view of the physical features of the district than possibly from any other point. Here, at the highest point, we get an elevation of 727 feet above sea level. Close to hand are the famous Rollright Stones, which are probably Druidical remains, but of which legend informs us that long, long ago, a Danish prince, consulting an oracle before invading this country, received the assurance—

“ When Long Compton you shall see
You shall King of England be.”

The landing was effected, and the invading force had almost reached the goal of their desires, when the prince, stepping forward to catch a glimpse of Long Compton, was, by a

patriotic British fairy, turned into stone, with all his attendant host. The block still stands near the highway, and near to this other groups of stones which are supposed to represent his knights.

Turning our backs on these remains, we look over a pretty fertile woodland valley. Immediately below us, about two miles distant, lies Long Compton, or, as it is sometimes called, Compton-in-the-Hole; the elevation here having fallen to 340 feet, but all around the country is elevated. In the north-east is the high land above Lower Tysoe, its highest point being 704 feet. In continuation of this is the elevated ridge forming the Oxfordshire boundary, over which is the highway to Chipping Norton, the highest elevation on this highway being 705 feet. Looking north, the view is bounded by the high land about Compton Wynyates, the highest point being 611 feet, and a little S.W. of this looms Brailes Hill, a noticeable object from most portions of the district; here the elevation is about 750 feet. Lying between this and the western boundary is the flat valley in which Burmington, Shipston-on-Stour, and Honington lie. Looking to the left, over the woodlands and heath lands of Barton-on-the-Heath and Wolford Wood, we see in the distance the western boundary of the valley; Ebrington Hill, and here near Ilmington Downs, is the highest point in the county, 855 feet; and Knowlands Hill, which is part of the same plateau, has an elevation reaching about 800 feet at its highest point. The northern boundary of the Stour Valley, the main road from Upper Easington to Banbury, is a slightly elevated ridge, the one side draining into the River Dene, the other into the Stour. The elevations on this road range from 331 feet to 412 feet. The north-west portion of this district is a flat, narrow valley, bounded by the Shipston Road. This, at Halford, has an elevation of about 200 feet, Whitechurch 133 feet, and at Milecote, which is close to the confluence of Stour and Avon, 120 feet. Of the geology of this district I am unable to speak with confidence. The prevailing soils appear to be those of the Lower Lias clays and limestone. The high lands forming the eastern border, which are a southern extension of the Edge Hill, are said to be formed by the marlstone of this series. At Brailes the Upper Lias clay is found. This, it is thought, once capped the marlstone there, and has since been denuded, leaving only the harder included limestone, (Fish-bed) portions of which are scattered in the fields below the hill. In some portions of the district light sandy soils prevail.

(To be continued.)

ON SOME AID RENDERED BY PHOTOGRAPHY TO GEOLOGY.

BY W. JEROME HARRISON, F.G.S.

Photography has rendered aid, in turn, to nearly all of the sciences, but I wish to note here just three cases which have lately come under my notice where it has been specially serviceable to geology.

In 1858 the question of the antiquity of man was brought prominently before the public by the discovery of flint instruments, clearly fashioned by human hands, in certain gravel-beds at St. Acheul, a suburb of the town of Amiens, in the north of France. These gravel-beds were deposited at some former period by the River Somme, but as the river now runs at a level ninety feet below these old gravels, it was admitted by all that the gravels were of very great antiquity. Besides the flint tools, these gravels contained many bones of animals, some of extinct species, such as the mammoth, cave-bear, &c. The French archæologists, M. Boucher de Perthes and Dr. Rigollot, had already collected hundreds of these flint implements from the gravel-beds when the question of their age was brought before the geological world. The leading men of science, both of England and France, were not at all prepared to accept the evidence afforded by the flint implements without strict investigation, and some of them, indeed, pooh-poohed the thing altogether. They insisted that the flints might have been made by the workmen engaged in the gravel-pits for the sake of the recompense they obtained when they found one (and certainly it was true that all the specimens hitherto discovered had been purchased from the men, or picked up on the floor of the pits). Others, more generous, believed in the authenticity of the specimens, but suggested they had been dropped down to the depth in the gravel-beds at which they were found, either by a settling of the strata, or through some crevice in the beds.

It was to settle this most interesting question that Mr. Prestwich (till lately Professor of Geology at Oxford) visited Amiens in the autumn of 1858. He superintended fresh excavations by the workmen, and shortly had the pleasure of uncovering with his own hands the end of a fine, well-shaped flint hatchet, lying at a depth of seventeen feet from the surface. This was convincing enough for Mr. Prestwich, but he wanted

to equally convince others ; so, fetching a photographer, several capital negatives were secured, showing the tool still embedded in the strata, and showing also, what was equally important, that there were no signs of any vertical rents, breaks, or any disturbances whatever in the overlying beds of sand and loam, which, indeed, contained many fresh water shells, and had, evidently, never been disturbed since they were deposited, long ages ago, by the River Somme.

The photographs so secured were presented to the Royal Society with the talented geologist's report, and carried conviction to many minds, so that many other inquirers visited St. Acheul, including Mr. James Wyatt, who, on his return to England, set to work and succeeded in finding precisely similar specimens in the gravels of the Ouse at Bedford.

The enormous period of time for which man has been an inhabitant of this earth is now clearly recognised, and no small share in the obtaining of this speedy recognition is due to Mr. Prestwich's photographs.

The second instance to which I refer was connected with the discovery of Dr. Rivière, of a skeleton of one of the early men by whom the stone tools were fashioned and used, and who were undoubtedly ignorant of the use of metals. It is singular that the bones of these early races of mankind should be so scarce ; their weapons we find in plenty, but of their bones hardly a trace. It was, therefore, a grand event when Dr. Rivière came across a complete skeleton of a palæolithic (or early stone-age) man in a cave near Mentone, in the south of France, in March, 1872. He had been excavating in a shallow hollow in the rocks, when he found the bones of a human foot, and this encouraged him to excavate the cavern, which proved to be of great extent ; forty-five feet in length—running north to south, opening towards the south—and of great height. The skeleton lay at a depth of seventeen feet, and was twenty-four feet from the entrance ; surrounding it and above it were fifty rude flint flakes, or scrapers, with many bones of animals, some of extinct species, but no trace of metal, pottery, or polished stone. The bones were those of a man five feet nine inches in height ; the skull was of a red colour, and was covered with a chaplet of perforated shells and teeth of stags. There the skeleton lay, a grand sight for the geologist, or the student of pre-historic man. But how to preserve a record of its exact disposition and appearance, a thing especially important, as the manner in which the body was laid out for interment—whether on the back or side, outstretched, or with the knees drawn up—is one of the characteristics by which its probable antiquity may be determined.

Fortunately the sun shone right down the cave, and it was an easy matter to secure an excellent photograph of the bones before they were disturbed.

Very many cases have occurred of the uncovering of skeletons and other objects in burial grounds, and even of the illustrious dead in our cathedrals, &c., where all trace of the objects faded away in a few minutes after exposure to the air; the bones crumbling to dust with a touch. If the forethought had been taken to have a camera at hand, many other pictures might have been secured of great value to the scientist and the historian.

Lastly, I am sure no one will acknowledge more freely the aid which photography can render to geology than that excellent geologist, Dr. Johnstone-Lavis, F.G.S., who is employing the camera freely as an aid to his studies of the volcanic phenomena of Vesuvius; studies which have now extended over some considerable time, and which are encouraged and aided by the British Association.

All volcanic regions are subject to rapid changes of form and level, and a record of such change is of the highest importance in the study of vulcanology. The cone of Vesuvius, we know, has undergone most wonderful changes in the past. The hill we call Monte Somma, and the lower elevation of La Pedimentina, are relics of an old cone of far greater dimensions than the existing one; and a series of photographs, showing the condition of the volcano at regular and frequent intervals since that mighty eruption in A. D. 79, which overwhelmed Pompeii, would indeed be interesting and important. But if it is not possible to now recall the past, we can at least provide for the future, and this is just what Dr. Lavis is doing, by securing almost daily photographs of the crater, plain, and the interior and exterior of the cone of eruption. These change rapidly, sometimes within an hour or two, and the changes afford an important clue to the nature and action of the important, but as yet somewhat mysterious, forces which are at work beneath Southern Italy. Some of Dr. Lavis's photographs were exhibited during the meeting of the British Association at Birmingham in 1886, and will be reproduced in a journal which is published by the Naples section of the Italian Alpine Club.

In writing these few lines I have merely jotted down the first three instances which occurred to me of the aid which photography has been able to render to one science only, viz., geology. Did time and space permit, books might be written describing the assistance which this young art—not yet half a century old—has rendered in all branches of science and art.

And yet nine out of ten people still think of photography as simply a mechanical method of taking portraits. Let it be the task of photographers—and more especially of amateurs—to show of what infinite applications, and those of the highest and most accurate nature, photography is capable.

SOME INVESTIGATIONS INTO THE FUNCTION OF TANNIN IN THE VEGETABLE KINGDOM.

BY W. HILLHOUSE, M.A., F.L.S.

(Continued from page 11.)

I germinated, alike in light and darkness, the following seeds, viz.:—*Cynoglossum officinale*, *Vicia Faba*, *Ricinus communis*, *Phaseolus multiflorus*, and *Helianthus annuus*, growing each, in the experiments in darkness, up to exhaustion point.

Cynoglossum vulgare in which, according to Schell, the tannin produced during germination is subsequently used up, I fully germinated. The testa of this oily seed contains no tannin; in the cotyledons, however, a certain amount is present. In the seeds germinated in light, a continuous, but variable, increase in the amount of tannin present is manifest. In those grown in darkness, the earlier stages of germination are likewise accompanied by an increase in the amount of tannin produced, but as the reserve food stores become exhausted, and no new food materials result from chlorophyll action, the contents of the cells become progressively more watery, and an apparent diminution of tannin contents takes place, but it is not at all clear whether this results from greater dilution or actual diminution. A comparison of the etiolated with the non-etiolated material gives distinctly the presence of larger quantities of tannin in the latter, but this by no means necessarily implies usage of the tannin in the former, owing to exhaustion of the food supplies, but may be due to no secondary food formation, with its accompanying tannin formation, taking place.

Vicia Faba is specially interesting owing to the tendency for tannin, here highly coloured brown, to accumulate in vertical rows of cells in the neighbourhood of the vascular bundles, especially in the primary root. In the lateral roots this is much less markedly the case. In the testa there is abundant tannin, and this in the process of germination undoubtedly largely diminishes, but here also an element of doubt comes in, as to whether the diminution is not due to

escape by diffusion in the partial decay of the testa. Judging from the nature and origin of the testa, evidence derived from changes in its cell-contents is as unreliable as can well be conceived. In this seed tannin is specially recognisable in the neighbourhood of the seats of growth, and with cell-enlargement apparently diminishes in quantity, but for reasons which I rather associate with dilution than with consumption. Here also plantlets grown in darkness show ultimately less tannin contents than those grown in light, but for reasons which I believe mainly, if not altogether, due to there being no secondary production of tannin.

The other seeds germinated give results which in all practical points agree with these.

Acorns and horse-chestnuts, self-sown and germinating in the open ground, although showing on July 18th incomplete exhaustion, gave no evidence differing from the above. In the seeds the quantity of tannin had in no way decreased, but rather, and in the case of the horse-chestnut notably so, increased. The whole seedling stem of *Quercus* showed very abundant tannin; the apparent consumption near the growing point referred to by Sachs (*l. c.*) might equally be due to dilution through cell-enlargement, accompanied by the removal of the free glucose.

It must, however, be further pointed out that in germinating seeds to exhaustion, in proportion as exhaustion approximates iron salts become increasingly more and more untrustworthy, an observation which completely tallies with the remarks made above upon the increased dilution of the tannin contents at the same period. It may be that this affords a clue to the differing results obtained by different investigators where iron salts have been used. Nor must the peculiarities of potassium bichromate in this respect be lost sight of; so that from all points of approach much is left to the judgment of the investigator. It may be further noted that the seeds in the germination of which in darkness tannin shows the most marked presence and the greatest appearance of diminution are those which, like *Ricinus communis* and *Cynoglossum officinale* are more or less rich in oil; this lends some support to the conception that tannin may be of some utility in such cases through its ready oxidisability.

Some investigations into the transfer to the stem of the cell-contents of the leaf prior to its autumnal fall in deciduous trees* show that in all cases where tannin is present in the living

* "Preliminary Notes on the Autumnal Fall of Leaves."—Report of the British Association, 1886, p. 700—1.

leaf it is present in apparently the same quantity and with the same distribution in the fallen leaf, *e.g.*, in *Æsculus Hippocastanum*, *Salisburia adiantifolia*, *Catalpa bignonioides*. On the other hand, these investigations have led me to look upon the complete emptying of the leaf of its starch cell-contents as the surest sign of approaching fall. A few evergreen shrubs which I have examined from the same point of view show the same more or less complete removal of starch from the leaf in winter, while, on the other hand, tannin may be present in abundance, *e.g.*, *Ilex aquifolium*, *Rhododendron ponticum*. I have examined about forty species of deciduous or evergreen plants, finding no essential divergence from these results.

I have made no observations upon the relations of tannin, with the ripening of fruits. Mack* and Haas† state that in the ripening of the grape the quantity of tannin diminishes. Buignet‡ had previously suggested this in various fruits. Observations with fruits must, however, be made with some caution. Artificial selection has tended naturally to the production, for edible purposes, of fruits in which the natural tannin contents are either diminished, or localised in certain special parts, such as skin, testa, &c., and this localisation may take place during the processes of ripening. In the second place, the same artificial selection may have established in cultivated fruits a tendency to transfer their tannin to the stem in ripening. Many fruits, however, ripen normally when severed from the parent plant, and if in such dissociated ripening analysis showed a reduction in the quantity of tannin contents, substantive evidence would undoubtedly be provided.

In the absence of any reliable method of separating tannin from free glucose, and further of separating tannin from the glucose with which it is loosely combined, micro-chemical investigations are prosecuted under considerable difficulties. No one would seriously dispute that in the processes of growth the free glucose could be separated out; nor is it in any degree improbable that in exhaustion experiments the "tannin" may be more completely reduced to the "tannic acid" state §; the point actually at issue is the decomposition of tannin in such way that tannic acid itself disappears by

* Mack, Bot. Jahresb., 1877, p. 716.

† Haas, Chem. Centralb., 1878, p. 700.

‡ Buignet, Ann. Chim. Phys., 1861, iii. Sér., Bd. 61, p. 281.

§ Compare in this connection the different appearance and aggregation of tannin masses in comparatively empty cells, as noted above.

consumption. Now, as far as these investigations go there is, and in their progress it was to me a source of surprise, no evidence to show that this takes place. Rearrangements, alterations, concentration, dilution of tannin there may be, but they all point to the same conclusion, viz., that tannin, once formed, is not used up in the further processes of growth, except, perhaps, in the formation of resin; and in this the evidence completely coincides with the non-transfer of tannin from falling leaves, and from the leaves of evergreens in winter.

It is quite true that the general distribution of tannin in *living* tissues practically coincides with the distribution of starch, or of glucose; but this distribution is equally compatible with either theory, by product or formative substance. Its absence from sieve-tubes is of importance in this respect, if, as the few notes I have bearing directly upon this lead me to believe it is, indeed, general. Nor is the fact that it may change in quantity in a particular part at different times of direct importance to the question, since it would be, indeed, remarkable were a body which exists dissolved in the cell-sap not to be transferable.

Leaving on one side then the other possibilities for tannin, such as its relations with other secretions, or with the colours of plants, the possibility that by its ready oxidisability it may play some collateral part in plant-chemistry, or that, since it does not furnish a good nidus for fungoid organisms, it may in some way protect the dead or dying parts of the plants from diseases due to their attacks; putting these on one side, evidence does not support the view that tannin functionates as a food-material analogous to starch, glucose, or oil.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

(Continued from Vol. X., page 305.)

HOW QUICKLY WOULD RESULTS BE SHOWN?—The effect produced by letting water into such a tilted triangular area as has been described would be most rapid at first, and became gradually less apparent as a larger area had to be filled, for at first it would not be possible to extract a large amount of water, and therefore more would be available for filling up the bed. The pressure of water, on which of course the yield of a well chiefly depends, would be approximately

proportional to the distance away, in the direction of out-crop, at which the bed was saturated, allowance being made in this particular case for increase of dip; whereas, the area to be filled would be proportional to the square of that distance. Taking the data already given as sufficiently accurate, it follows that about seventy-five millions of gallons would be required for the first mile, and it would raise the head of water $9\frac{1}{2}$ feet, whereas two miles would require about four times the amount of water, but would only raise the head nineteen feet, and so on.

Considering, therefore, that the Northampton well resuscitated itself so well in about two years, without assistance, it is evident that the near Marlstone had a considerable amount of water left in it when pumping was stopped, although the pressure was not sufficient to deliver it in large quantities; it thus becomes an indirect proof of the small inclination of the bed near the town.

I have endeavoured to show that there is no natural obstacle to a head of 110 feet of water being obtained at Northampton. Without the aid of headings, a yield of over 800,000 gallons per day was obtained when the artesian rest-level was ninety feet; therefore, with a rest-level of 110 feet, 1,000,000 per day would now be obtained. This would be sufficient for the present use of the town, and perhaps as much as could be expected from a single well. A dozen *dumb-wells* ought to supply this amount of water, and at the same time continuously improve the yield up to the greatest limit. There is no doubt that one of these wells, when empty, and supplied with clear water, could dispose of 1,000,000 gallons in a day, but considering that they would not be empty even when first made, and that the flow of water would be impeded by the filling of sand and gravel, and that that amount of water would not be continuously available, I have assumed a limit of 100,000 gallons per day on an average, or 1,200,000 gallons altogether. This amount, together with that impounded naturally, would give an immediate increase of the water supply, followed by a continuous improvement in the yield up to the maximum amount. A single year would suffice to make the supply equal to the bare necessities of the town, without extraneous aid, for with a daily loss of 400,000 gallons, there would be a residue of 365,000,000 of gallons on the year.

In connection with the available supply of water, it is somewhat important to know if the river grave taps the river. Speaking generally, I should say it does not for the river, in most cases, flows over a good thickness of the dirty alluvial

clay previously described, the river gravel being below. Also the fall of the river from Northampton to the sea is so small that there is always a tendency to further silt up its bed, and so prevent leakage. It was ascertained that there was no leakage from the river into the gravel at the Gas Works, Northampton, when making excavations for a new gasometer; also none was detected when the large culvert was carried across the Cow and Midsummer Meadows to the Sewage Works. On the other hand, a well in the river gravel, near to the St. James End Ironworks, and only a little westward of the Gas Works, evidently tapped the river, for the water always stood at the same level in each after a rest. There was little or no true alluvium where this well was made. One instance where the river was tapped has come under my notice. When digging the foundations for some new buildings at Nun Mills (Mr. Westley's) the alluvium was pierced, and the river gravel reached, the latter dipping in the direction of the old mill at the rate of seven feet in forty. Whilst work was going on pumping had to be continued, but on a particular Sunday it was noticed that the water in the river and the opening made into the gravel stood, as nearly as one could judge, at the same level, and as the water in the river sank during the day, so did that derived from the gravel. Of course both alluvium and gravel may have been much disturbed here when making the original mill and mill-head. The culvert referred to is only a very short distance away from this mill on the other side of the river. Numerous wells have been made to obtain water from the river gravel, but in no other cases than those mentioned, so far as I know, has there been any reason for suspecting that the supply was fed by the river. It, therefore, appears pretty certain that no considerable draining of the river would take place.

The supply of water to the proposed dumb-wells would, during flood time, be equal to their utmost capacity for receiving it, and during nearly half the year very considerable from incipient floods. I have been assured by a gentleman, who knows the Nen valley and its adjacent lands well, that many streams might with advantage be diverted into shallow holes for several months in the year, and some of the disadvantages incident to land drainage thus obviated, but a consideration of this will come better in Part V.

IV.—WOULD THE WATER BE PURE ?

It will be generally admitted that the water usually obtained from the Marlstone, including that supplied to Northampton from the same source, is good. There is no

reason to doubt that the water artificially let into the Marlstone would be equally pure, and there are several decided advantages in collecting and storing the water in underground reservoirs rather than in open ones, which must be more or less evident to everyone.

Flood water and river water in the *early stages* of a flood are more impure than at other times, owing to the washing of lands on or in which impurities have been accumulating, and the displacement of water from springs or subsoils where it has been stagnating, though in the later stages of a flood river water appears to be more than usually pure.* Notwithstanding this, I think I may claim that *the water to be utilised by this scheme would not, in the first instance, be more impure than some which is now used for the supply of towns, after artificial filtration*, whilst the arrangements for purification are *much* more perfect than any adopted by these towns; let me call attention to them.

There are special arrangements for filtering the water before it reaches the well. The flood water can only enter the dumb-well after passing over soil covered with vegetation, then through soil or sand and drain pipes, or, if it comes from the river, through a considerable amount of sand or gravel, and by either of these processes it would be completely clarified. The water which is now obtained from the river gravel is perfectly clear and bright, and contains, as a rule, nothing actually injurious, though the quantity of nitrates present would be, in this case, interpreted as a proof of previous contamination. This speaks well for the bed, though not for the water now contained in it, but with a larger and more rapid circulation of water this suspicious character would diminish, and the total solids become less.

The water would be well filtered in the wells themselves by a quantity of sand and gravel at least five or six times as great as that considered sufficient for the filtration of Thames water by the London Water Companies.

The water would be again filtered in the Marlstone itself, a filtration of a most perfect kind, and probably quite sufficient without any artificial aid. I have no hesitation in saying that there is no artificially collected water in this country so well filtered as this would be before reaching the pumping station.

* For particulars on this and other points connected with rivers, see "River Water," by C. Meymott Tidy, M.B., M.A., M.S. Journal of Chemical Society, May, 1880.

The water would be well aërated by the fall into the dumb-wells. This aëration is a very important matter in the purification of water, and yet it seems to be rather neglected in most arrangements for the artificial purification of water. The best proof of the value of aëration is found in the fact that the free oxygen in water is always in the inverse ratio of the organic contamination.

Water collected and stored as suggested would be perfectly safe until wanted, it would be of an equable temperature all the year round, *cool and refreshing in summer, and not liable to freeze in winter*, in these respects being far superior to water stored in open reservoirs. A large open reservoir must during the summer months breed large numbers of infusorial animals, and although these may be removed by the filter beds, the water is liable, on account of its temperature, to again breed such afterwards.

One other advantage of the underground reservoirs might be here pointed out—*the filter beds cannot be overtaxed so as to supply imperfectly filtered water.* Of the water which is put in, it may be months or even years before that same water is utilised in the town, and in all cases it would amount to a considerable interval of time, because it could only reach the pumping station by pushing other water before it through the filtering medium, and being itself pushed.

The following remarks, quoted from Mr. C. E. de Rance's work "The Water Supply of England and Wales," are very pertinent to the question here dealt with.

"In regard to their general fitness for drinking and cooking, the Rivers Pollution Commissioners classify waters in the order of their excellence, in respect to wholesomeness and palatability as follows:—

| | | | | |
|------------|---|--|---|--------------------------|
| Wholesome | { | 1. Spring water | { | Very |
| | | 2. Deep well water | | palatable. |
| | | 3. Upland surface water | | Moderately palatable. |
| Suspicious | { | 4. Stored rain water | | |
| | | 5. Surface water from cultivated land | { | Palatable. |
| Dangerous | { | 6. River water which sewage gets access to | | |
| | | 7. Shallow well water | | |

The value of spring and deep well water is not merely due to their great intrinsic chemical purity and palatability, but to their being peculiarly suited for domestic supply, from their almost invariable clearness, transparency and brilliancy, and their uniformity of temperature throughout the year, rendering

them cool and refreshing in summer, and preventing their readily freezing in winter; and their utilisation and conservation appear to be a matter not only worthy of enquiry, but one of National importance, and to demand Imperial legislation.

The Commissioners state that only water derived from wells more than 100 feet in depth, and from deep-seated springs can be considered reasonably safe, for in these the organic matter contained in the water is rapidly oxidised in percolation through porous and aërated soil and permeable rock."

(*To be continued.*)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(*Continued from page 21.*)

WILLIAM SCOTT, "STOURBRIDGE AND ITS VICINITY."

† *J. setaceus*. Morasses, banks of streams, and other humid sites.

This must be an error for Scirpus setaceus, but this plant is mentioned further on.

* *Scirpus palustris*. Pool near the Heath.

† *S. lacustris*. Chickhill Pool, Himley, and other localities in Stafford.

This is the plant communicated to Purton as S. carinatus.

* *S. setaceus*. Pedmore Common; field adjoining Mount Carmel.

† * *S. acicularis*. Reservoirs, &c.

Query county?

† *S. pauciflorus*. Reservoirs, &c.

Query county?

* *Eriophorum (angustifolium)*. Meadows in the Vale of Stour; Pedmore Common.

Carex paniculata. Marshes near the Heath and on the Stour.

† *C. teretiuscula*. Marshes near the Heath; banks of Stour; Harborough Pool.

I suspect an error for a narrow form of C. paniculata.

C. vulpina. Banks of Stour and canals.

C. muricata. Hill Pool Holloway; Ismere.

* *C. remota*. Hagley Park.

C. ovalis. Hungary Hill.

† *C. stricta*. Marshes. *An error.*

† *C. cæspitosa*. Carnation grass. Uplands near Wychbury. *An error.*

C. cæspitosa, Good., is *C. vulgaris*, Fries; this however cannot be the plant intended. I suspect *C. stricta* to be an error for *C. vulgaris*, and *C. cæspitosa* an error for *C. glauca*.

† *C. limosa*. Wychbury Uplands. *An error.*

It is difficult to imagine what can have been intended by this name.

C. pallescens. Cradley Park.

C. strigosa. Cradley Park.

C. sylvatica. Cradley Park.

† *C. distans*. Cradley Park. *An error.*

C. fulva. Cradley Park.

* *C. flava*. Fields near Cradley. *Probably var. minor.*

* *C. pendula*. Harborough Pool.

C. hirta. Banks of streams.

† *C. vesicaria*. Reservoir. *Query where?* Probably in Stafford.

C. riparia. Banks of Stour.

† *Panicum verticillatum*. *No locality.*

Anthoxanthum odoratum. Grass fields.

Phleum nodosum (*a var. of P. pratense*).

Agrostis alba. }
A. stolonifera. } *Forms of one species.*

A. nigra. *Form of A. vulgaris.*

Arundo colorata. Near Broughton Village.

A. colorata (*Hortus Kewensis*, p. 116), is *Phalaris arundinacea*, L.

A. Phragmites. S. of Worcester.

Milium effusum. Woodlands.

* *Aira caryophyllea*. Commons.

A. præcox. Commons.

A. flexuosa. Woods and Commons.

A. (Catabrosa) aquatica. Lusbridge Brook.

* *A. (Koeleria) cristata*. Commons.

It is strange that this grass, which is comparatively rare, should be given without locality.

Avena elatior (*Arrhenatherum avenaceum*). Grass fields.

A. flavescens. Grass fields.

Holcus mollis.

H. lanatus.

† *H. bulbosus.*

I suppose a bulbous variety of mollis to be intended by this name.

* *Melica uniflora.* Cradley Park.

† *M. nutans.* Woods.

It is surprising that this rare grass should be inserted without locality. It does not now occur in the Stourbridge neighbourhood. I suspect an error.

* *M. (Molinia) cærulea.* Marsh near Pedmore Common.

Poa trivialis.

P. pratensis.

† *P. elatior.*

I do not know what was intended by this name.

P. (Glyceria) aquatica. Rivers and morasses.

P. (Glyceria) fluitans. Lusbridge Brook, Broughton Brook near the village.

† *P. (Sclerochloa) distans.*

Must, I think, be an error.

P. (Triodia) decumbens.

† *Briza minor.* Grass fields.

Must be an error for B. media.

Cynosurus cristatus. Roads, fields.

Dactylis glomerata. Commons and fields.

Festuca Myurus. Commons and roadsides.

* *F. ovina.* Commons and hedge banks.

F. rubra. Commons.

* *F. duriuscula* (var. of preceding). Commons.

* *F. loliacea.* Cradley Field.

F. pratensis. Fields.

† *F. arrow-headed.* A temporary name. Pedmore rocks; Cookley; Bredon Hill.

What is meant by this?

* *Bromus giganteus.* Woods, &c.

B. secalinus. Woods, &c.

B. sterilis. Woods, &c.

* *B. sylvaticus* (*Brachypodium sylvaticum*). Woods, &c.

Triticum repens.

† *T. junceum.* Fields between Pedmore and Hagley. *A very doubtful record.*

T. caninum. Woodlands.

* *Hordeum pratense*. Scattered variously, luxuriant. Beckford near Evesham.

Lolium perenne. Grass fields.

* *Nardus stricta*. Commons.

* *Asplenium Trichomanes*. Cookley.

Scolopendrium (vulgare). Rocks near Bell's Mill; Chaddesley; Hill Pool; very rare.

† *Lycopodium clavatum*. Whittington Common (*Stafford*); very rare.

Scott deserves our gratitude notwithstanding the imperfection of his work, as his Catalogue yields many new county records.

(*To be continued.*)

PASSAGES FROM POPULAR LECTURES.

BY F. T. MOTT, F.R.G.S.

III.—BINOCULAR VISION.

FROM A LECTURE ON "ARTIFICIAL EYES," 1867.

[NOTE.—Numbers I. and II. of these "Passages" will be found in the "Midland Naturalist, Vol. I., page 29, and Vol. II., page 29. The series was cut short by other engagements. I propose now to continue it.—F. T. M.]

Having two eyes, why do we not see everything double? The first answer is that we do see many things double; more, probably, than most of us are conscious of. There are certain conditions under which we see things double, and certain others under which we see them as one only. Probably infants in their earliest months see everything double. If you hold up your finger between your face and some other object not very far off, and then look at the finger you will see two images of the other object, and *vice versâ*. If you are foolish enough to drink beer or brandy to excess, so as to over-stimulate and confuse the brain, you will most likely experience double vision, accompanied by other curious and undesirable symptoms.

Single vision with two eyes, like the hearing of one sound with two ears, seems to depend upon a combining power which the healthy brain possesses, partly due to the fact that the optic nerves are actually united within the brain, and partly to experience acquired in very early life. But one necessary condition is that the eyes should be both directed

to the same point at the same time. It may be easily conceived that if both eyes are turned to the same point, so that there is on each retina a precisely similar picture, the two impressions coinciding in the brain may be received as one. But in looking at any solid object the two pictures formed in the eyes are not precisely similar ; the left eye sees a little more of the left side of the object, and the right eye a little more of the right side of it. Each eye sees a little way round the corner on its own side, so that there is a slight difference in the two pictures. What, then, does the brain do in this case ? Instead of making a confused image of the whole, it combines what is alike in the two pictures, and adds on the surplus at each side, the result being an impression of *thickness*, as well as of length and breadth, of relief, of comparative distances, of perspective.

Shut one eye, and you will find that everything seems flatter, more like a painted picture than when you see it with two eyes. A person suddenly deprived of the use of one eye feels at a loss about the distances of objects at first, but the brain soon learns to work under its altered conditions, and after a few days' experience the sense of perspective is nearly as strong as before.

When you look at a landscape with the head inverted (looking under the arm or between the legs), you say " It is like a picture ! " What you mean is that the perspective has in a great measure disappeared. The foreground has gone back, and the background has come forward. Everything looks nearly in the same plane, and the effect is strange and rather pretty. The reason is that the brain is not accustomed to estimate distances with the eyes in that position, and cannot do it completely on a sudden demand. If you thought it worth while to remain upside down for a week you would find the perspective come back again, and your pretty picture fade away into a real landscape.

On this principle of binocular vision Sir David Brewster founded his invention of the stereoscope, one of the most beautiful and interesting of scientific toys. Scenes and objects which are far removed out of our sight it sets before us with life-like roundness and reality. It makes artificially upon the retinæ of the eyes the two slightly different pictures which the right and left eyes would make for themselves if they had the real object before them. The brain does its work regardless of the deception. What is alike in the two impressions is combined into one, the surplus is added at each side, and the effect of relief is produced as perfectly as if the object itself had sent its light-rays into the eyes.

The essential elements in stereoscopic pictures are, of course, that they should be taken from two points of view not less than $2\frac{1}{2}$ inches asunder, which is the average distance of eyes from centre to centre; and that they should be fixed upon the card so that there is the same distance between them, point for point. If they are taken from points of view less distant than $2\frac{1}{2}$ inches, the proper effect of relief will not be produced. If that distance is much exceeded an exaggerated relief will be the result. In taking views of distant objects this exaggerated relief is always given, because without it no stereoscopic effect would be perceived. Our natural eyes being only $2\frac{1}{2}$ inches apart, are not able to see round the corners of any object which is more than 30 or 40 feet distant from us. In taking stereoscopic views of objects or landscapes more distant than this, the points of view are more widely separated in order to get the effect which the eyes alone could not get, and no doubt this unnatural perspective makes the resulting picture in the stereoscope still more surprising and wonderful to us.

The instrument itself is a very simple but very ingenious contrivance. Its object is to refract the light-rays from two pictures so that they shall appear to the eyes to emanate from one only. This is done by taking a common double-convex lens, cutting it across the centre into two halves, and turning these two halves round so that their thin edges come together and their thick parts are turned outward, right and left. The two halves are then cut circular or square, and fixed into the frame, and the result is that the two pictures appear to overlies one another just as if the eyes were converging upon one object.

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

EXPOSITION OF CHAPTERS XII. AND XIII.

MULTIPLICATION OF THE HUMAN RACE.

BY ALFRED HILL, M.D., F.I.C.

The inverse variation between the generative function and the preservation of the individual, or, as Mr. Spencer otherwise expresses it, between Genesis and Individuation, is universal. Man's very slow rate of multiplication—lower

than that of any mammal except the elephant—is the natural result, says Mr. Spencer, of his higher evolution. and changes of bulk, structure, or expenditure will be found to be the causes of changes in the degrees of his fertility. Where there is much expenditure, as in man and most of the higher animals, genesis commences only when growth and development are nearly completed, continues during the prime of life, and ceases when the vigour declines. There is, too, a period when fecundity culminates—in women it increases up to about the age of twenty-five years, but gradually wanes after the age of thirty; increase in weight and size of the offspring also accompany increase of fecundity, and *vice-versâ*, both in cases of uniparous and pluriparous animals, while a too early bearing of young causes arrest of growth and enfeeblement of constitution. There is, in fact, evidence that what causes increase or decrease of genesis in other creatures does so in man, though only few unobjectionable comparisons can be made, because the human races differ considerably in size, and notably in their degrees of cerebral development; the quantities and qualities of their food are unlike, greatly on account of differences in climate, and their expenditures in bodily, and more particularly mental, action are extremely unequal.

That increased fertility accompanies a nutrition in excess of expenditure is shown by contrasting populations of the same race, or of allied races, which are differently nourished, and Mr. Spencer cites three examples of this:—

(1.) That of the idle, stupid, and self-indulgent Boers, who not uncommonly have from twelve to twenty children.

(2.) That of the cruelly used Hottentots, who do all the work for the Boers, and who seldom have more than two or three children, while the well-fed Kaffirs are very prolific.

(3.) That of the French Canadians, who live in a region where subsistence is easily obtained, and who pass a considerable portion of the year in idleness, and have large families, in contrast with the Anglo-Saxon Canadians, who, leading lives of excessive activity, have a low fertility. Mr. Spencer argues that though the case of the Irish peasantry may appear adverse to this view, their rapid multiplication may be due to earlier marriages, and consequent quicker succession of generations, to greater generality of marriage, and particularly to the fact that they obtain a return of food that is large in proportion to the amount of labour expended in procuring it. A good surplus is, therefore, left for genesis—a greater surplus probably than remains to the English peasantry, who,

though better fed, are harder worked. Mr. Spencer draws the conclusion that in the human race, as in all other races, such absolute or relative abundance of nutriment as leaves a large excess after defraying the cost of carrying on parental life, is accompanied by a high rate of genesis.

The converse truth that relative increase of expenditure, leaving a diminished surplus, reduces the degree of fertility is next dwelt upon. Much bodily labour is said to render women less prolific, and there is some evidence of this. According to De Boismont, of France, and Dr. Szukits, of Austria, the reproductive age is reached a year later by women of the labouring classes than by those of the middle class. The low rate of increase in France is probably due partly to the hard work thrown on the women by the abstraction of men for non-productive occupations, military and civil, while the higher rate of increase in England is probably furthered by the easier lives which English women lead.

Mental labour is more easily shown to be the cause of absolute or relative infertility; for instance, upper-class girls have a less productive power than poor girls, though their food is better; the greater tax on their brains reacts on their physique. This diminution of reproductive power is shown by absolute sterility, earlier cessation of child-bearing, and frequent inability to suckle their infants. The antagonism between Genesis and Individuation is not often shown in men by suppression of generative power consequent on unusual expenditure in bodily action, owing to the cost of reproduction being much less in men than in women, but the ancient *Athletæ* are said to have rarely had children, while "trainers" insist on continence. Cerebral expenditure is believed to diminish generative power, and intense application to mathematics and the excitement of gambling are said to have had this result, while men of unusual mental activity often leave no offspring.

Two objections have to be guarded against here. The first objection is that since civilised races are on the average larger, more complex, and more active than uncivilised, they ought, according to the alleged general law, to be less prolific, whereas there is no evidence to prove that they are so; on the whole, they seem rather the reverse. The answer is that, were all other things equal, these superior varieties of men would have inferior rates of increase, but other things are not equal. Domesticated animals are more fertile than wild ones; the causes are the same that render civilised more fertile than savage men. Then there are differences in the amount of food. Many races with low rates of mortality are

underfed. They eat their food raw, instead of cooked, prepared, and selected, so that their food costs more to masticate and digest. They get their food irregularly—short periods of gluttony alternate with long periods of want. Then, again, the supposed greater consumption in muscular action undergone by civilised men than by savages is only apparent. The chase is very laborious, and the uncivilised not only undergo great exertion in seeking and securing odds and ends of wild food, they lack good shelter and protection from cold, insects, and other sources of wear and tear.

A kindred objection is that there are cases where there are high powers both of self-preservation and race-propagation. This result is the consequence of “a goodness of constitution,” resulting in a better internal utilisation of materials. To illustrate this, Mr. Spencer takes the case of a steam engine. The fuel he compares with food, the steam employed in working the engine with Individuation, and the waste steam with Genesis. Of these conditions several variations are possible. There may be a structural or organic change of proportion by enlarging or diminishing the safety valve, &c. There may be a functional change of proportion owing to the engine having to draw a heavier load or maintain a higher speed, and *vice-versâ*, and there may be coincident variations such as that produced by the greater quantity of steam supplied by the use of more or better fuel. One case of coincident variation is parallel with the case under consideration—that of the augmentation of individual expenditure and of reproductive energy that may be caused by a superiority of some organ on which the utilising of materials depends—it is where more steam is produced from a given weight of fuel by improvement of the steam generating apparatus.

Thus far, says Mr. Spencer, “we have observed how by their extremely high evolution and extremely low fertility mankind display the inverse variation between Individuation and Genesis in one of its extremes. And we have also observed how mankind, like other kinds, are functionally changed in their rates of multiplication by changes of conditions. But we have not observed how alteration of structure in man entails alteration of fertility.” This is too complicated a problem to be dealt with otherwise than deductively.

HUMAN POPULATION IN THE FUTURE.

The Evolution of Man must be of the same nature, says Mr. Spencer, as Evolution in general. *Structural* Evolution may consist in greater integration, or greater differentiation, or both; in other words in larger size, greater heterogeneity

and definiteness, or both. *Functional* Evolution may consist in more actions, greater varieties of actions, or both, resulting in more complete co-ordination of actions, in other words, "an advance towards completion of that continuous adjustment of internal to external relations which constitutes life."

Mr. Spencer pauses here to enquire in what particular way the higher life may manifest itself. He considers that it will probably not show itself in any considerable degree in strength or in agility, though it may to some extent in mechanical skill, but that it will most likely manifest itself in intelligence, for which there is ample room for advance, and in morality. There will be greater exertion of the will to do what our intelligence tells us we ought to do. In short, this more perfect co-ordination of actions is likely to take mainly the direction of a higher intellectual and emotional development.

This conclusion is strengthened by an enquiry into the causes which are to bring about such results. Evolution is never spontaneous; all modifications, structural or functional, must depend on surrounding conditions. What are the changes in the environment to which the human organism has been adjusting and will continue to adjust itself? How, too, do they necessitate a higher condition of the organism?

While danger of death from predatory animals and from tribal combinations lessens as men grow more numerous, that from deficiency of food increases. Growth of population is therefore a permanent cause of modification to which civilised men are exposed. This constant increase of population beyond the means of subsistence stimulates the gradual growth of skill, intelligence, and self-control. Without this pressure of competition there would be no necessity for more thought and energy to be applied to the business of life, and growth of mental power would cease. Nothing but necessity could induce men to submit to the discipline of labour and self-denial, and nothing but this discipline could produce a continued progression. Nature, in fact, secures each step by a succession of trials; all mankind subject themselves more or less to the discipline, but all do not advance under it, and only those survive who do progress, while those who are not so stimulated to greater activity are on the way to extinction, as recently exemplified in the case of Ireland. Premature death operates in the same direction, for "natural selection" causes the fittest to survive. In this way there is a constant progress towards higher skill, intelligence, and self-regulation, better co-ordination of actions—a more complete life.

We have thus arrived at the proposition that excess of fertility is itself the cause of man's further evolution; the corollary, says Mr. Spencer, is that man's further evolution thus effected necessitates a decline in his fertility. The future progress of civilisation produced by the never ceasing pressure of population will be accompanied by an enhanced cost of Individuation, especially in nervous structure and function, an increase of the great nervous centres in mass, complexity, and activity. More emotion is the correlative of a larger brain, higher feeling of a more complex brain, more feeling and thought of an active brain, so that the nervous system must become a heavier tax on the organism. Already the brain of the civilised man is nearly thirty per cent. larger, and is more complex in its convolutions, than that of the savage. Mr. Spencer concludes, therefore, that the particular kind of evolution, which man is hereafter to undergo, may be expected to cause a decline in his power of reproduction. He would not let us assume, however, that this greater expenditure in nervous action necessarily implies a more mentally-laborious life. The greater emotional and intellectual power and activity will gradually become organic, spontaneous, and pleasurable, just as the mental effort of an accomplished man is trifling compared with that of an illiterate one.

What, then, is to be the limit of this progress? As long as fertility exceeds mortality the population must increase; as long as there is pressure on the means of subsistence further mental development and further diminution of fertility must result. The change must therefore go on until the rate of multiplication exactly equals that of mortality. At first sight this would seem to imply that eventually each pair will rarely have more than two offspring, but this is not so, as the number of premature deaths can never become so small as to allow the rate of multiplication to fall so low. It is manifest, however, that in the end pressure of population and its accompanying evils will disappear, and only normal and pleasurable activity will be required from each individual, for cessation in the degree of fertility implies cessation in the development of the nervous system, which further implies that the latter has become equal to the work demanded of it—has not more to do than is natural to it. But exercise of the faculties within natural bounds constitutes gratification, therefore in the end the obtainment of subsistence and discharge of all the parental and social duties will require just that kind and that amount of action which are needful to health and happiness. We see then, says Mr. Spencer, that the

antagonism of Individuation and Genesis ensures the final attainment of the highest form of maintenance of race—the greatest amount of life possible, and the fewest number of births and deaths. Fertility has brought about civilisation, civilisation will diminish fertility and destroy its excess. From the beginning pressure of population has been the cause of progress. It produced the original diffusion of the race, it compelled man to take to agriculture, it forced men into the social state and developed the social sentiments, it has stimulated us to increased skill and intelligence, and it is daily thrusting us into more mutually-dependent relationships, and, after having caused the due peopling of the globe, and the raising of all its habitable parts into the highest state of culture, and developed the intellect into complete competency for its work, and the feelings into complete fitness for social life, it must gradually finish its work and bring itself to an end. Evolution is, in fact, an advance towards equilibrium.

He concludes by observing that the final result is that “in approaching an equilibrium between his nature and the ever varying circumstances of his inorganic environment, and in approaching an equilibrium between his nature and all the requirements of the social state, man is at the same time approaching that lowest limit of fertility at which the equilibrium of population is maintained by the addition of as many infants as there are subtractions by deaths in old age. Changes numerical, social, organic must by their mutual influences work unceasingly towards a state of harmony—a state in which each of the factors is just equal to its work.”

[These Expositions of Herbert Spencer’s “Principles of Biology” are now concluded. They commenced in vol. VII., p. 35.]

Notes.

HOAR FROST IN JANUARY, 1888.—FACT AND THEORY.—Having occasion yesterday at noon (12th January) to make an observation with an anemometer in the mouth of a rectangular wooden pipe, fixed vertically into the ground and communicating ventilation to some underground excavations of a fire-clay mine near here; it was necessary to remove a square of wire gauze (whose meshes were $\frac{3}{16}$ inch square), which had been nailed over the mouth of the said pipe to protect it. Now, covering the upper surface of this wire gauze was a beautifully evenly-formed layer or cake of cellular ice or hoar frost, very much resembling the comb of the honey bee, only the cells were four-sided instead of

six. I noticed that the walls of these ice-cells had formed upon the upper surfaces of the wires of the gauze, and were about the same thickness as the wires; that the cells themselves all sloped very much—probably at about an angle of 45° with the horizontal piece of gauze—and that their axes all lay in the same direction, namely, facing that from which the wind blew (N.W., but almost a dead calm, with a very steady barometer at about 30.70 s.l.). The length of the cells was about half-an-inch, though near the edges of the pipe they were shorter. The direction of the air flowing through the gauze was inwards and vertically downwards, the quantity being about 100 cubic feet per minute, the area of mouth of pipe being 50 square inches. A thick fog prevailed, but the air temperature was from two to three degrees *above* freezing point, and there had been no frost the night before. This peculiar formation of frozen fog seems to me to be accounted for in this way:—The cold foggy air being sucked rapidly through the meshes of the gauze became so much reduced in temperature, due to *rarefaction*, as to cause it to fall below 32° F., and to be converted into hoar frost or ice, and, as long as the conditions remained the same, the ice cells grew outwards or in the direction of the in-rushing air, coming, as already mentioned, from the N.W. I have often observed, too, that long-pointed horizontal crystals of hoar frost rapidly form along a door-sill, just beneath the bottom of the door, in cold thick-foggy weather during a calm. When this is the case a strong current of air is passing through the chink *from* the open air. In these instances also the ice-needles grow outwards, or in the direction whence the air comes in. I suppose here, again, we have the same cause, namely, reduction of temperature, causing ice to form as described. But whether such objects as spiders' webs, long grass, twigs, sharp edges of posts, telegraph wires, &c., are directly concerned in the formation of hoar frost or not I am scarcely able to say, unless it be that they cause a local lowering of temperature and, therefore, a deposition of ice particles. Whether there is anything new in this idea of mine I cannot say, but I do not find the (?) *theory* in print.

Overseal, 14th January, 1888.

W. S. GRESLEY.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GEOLOGICAL SECTION.—January 17th. Chairman, Mr. T. H. Waller, B.A., B.Sc. Mr. Waller, B.A., B.Sc., was re-elected President of the Section; Mr. Udall, F.G.S., was re-elected Secretary of the Section; Mr. Thos. E. Bolton, son of the late lamented Curator, was unanimously elected a life member. Specimens were exhibited by Mr. Mantell of Upper Cambrian rocks showing *Oleni* in black shales, and *Dictyonema* in grey shales. A paper was read by Mr. Waller—"Notes on Serpentine Rocks," illustrated by microscopic preparations, including Picrite, Scyelite, &c.

VOLITION. *

 BY CONSTANCE C. W. NADEN.

What is a *voluntary action*? It is very easy to answer. "An action controlled by the will," or "An action determined by motives;" but we are only plunged into deeper perplexities, for we now have to seek a definition of "Will" and "Motive"—two elusive Will-o'-the-wisps, which will lead us on till we lose footing in metaphysical swamps. Even if we turn away from metaphysics altogether, and question anatomy and physiology, we are not much enlightened, for many actions which follow on stimulation of the so-called "voluntary" muscles are by no means voluntary. The only way of getting an answer is, apparently, by interrogating our own consciousness; the distinction between volition and automatism or volition and impulse is primarily psychological. It has, as I hope to show, its grounds in physiology also; but, as a mode of classifying actions, it should be reserved exclusively for psychology.

Under the term "action" I shall include every modification of the organism which results from its own internal activity. It would be wrong to confine the word to those external manifestations which make up the visible life; for although I *will* to move my arm, and not to contract a set of muscles, still the muscular contraction is the immediate sequence of my volition. I eat to live, not to excite the gastric glands; but the gastric glands help to carry out my purpose by their involuntary and unconscious activity. An action, then, may be a muscular contraction, a secreting process, or a neural process, or the inhibition of any of these.

First, let us look within for the meaning of "Volition" and "Voluntary," putting aside all preconceived notions about the freedom of the will, and its power of proceeding in diametrically opposite directions under precisely similar conditions; putting aside those questions of "fate, free-will, foreknowledge absolute," which occupied Milton's fallen angels, and confining ourselves to the facts of mental experience. I think we shall find that what, in common parlance, we mean by a "voluntary action" is simply an *action accompanied or immediately preceded by a conscious mental*

* Read at a Meeting of the Mason College Physiological Society, February 8th, 1887.

effort in its own direction. I cannot find that anything more than this is involved in the idea. Conflicting motives appear only in the very highest class of voluntary actions; in those which follow a certain period of reflection and deliberation, and which, to pre-evolutional psychology, were the chosen types of volition. But the embryology of "Will" is more instructive than its mature development.

Even the "conscious mental effort," which may seem so trivial an expression to denote the awful majesty with which "Will" has been invested, is sometimes so slight as to be barely perceptible. The boundary between volition and automatism is very vaguely defined. I set out to walk; the first step is not automatic in the sense in which the succeeding steps are automatic, and yet the "conscious mental effort" is reduced to a minimum. Still it is there; and if my foot happens to be sore, the effort will be much more distinctly felt, and will increase with each step, instead of ceasing to exist. If my mind is passive, and open to every trivial fleeting suggestion, then its processes are effortless; but directly I begin to *attend* to anything there is a conscious effort, which corresponds to an actual nervous tension; but if the subject is interesting to me, and is one with which I am familiar, the effort may disappear from consciousness after the first moment. We understand a speaker in our own language without effort; his meaning comes to us whether we will or no; but there is always a certain effort required to follow a speaker in a language not perfectly familiar to us.

But instead of describing voluntary actions, I shall begin by very briefly classifying involuntary ones, not only because they form by far the larger division, but also because their characteristic physiological conditions are more positive, more definite, and hence more easily understood.

Involuntary actions fall naturally into two great classes, the *automatic* and the *impulsive*.

Automatism implies the existence of a more or less complete nervous and muscular mechanism, which renders the exercise of certain functions easy, and, under given circumstances, inevitable. The current of nerve-energy always flows in the direction of least resistance; in the case of automatic actions, there is no perceptible resistance along a certain definite line, while all other lines are more or less blocked.

Lowest of all are the *primary* automatic actions, which have nothing to do with consciousness, and are performed perfectly by the new-born infant. These include breathing, coughing, sucking, the organic functions, and various reflex actions depending upon the medulla oblongata, the spinal

cord, or the sympathetic ganglia. These do not require the co-operation of the cerebrum, and may be performed by an acephalous child.

Next in order come the *secondary* automatic actions, which do at first require a conscious effort, but which after frequent repetition become organic habits so that they are effortless, and often unconscious. But some of these, indeed perhaps the larger part, avail themselves of an inherited but imperfect nervous mechanism, which would be better called an organic predisposition. These may be subdivided into three groups.

The first group is called *excito-motor*, and depends upon the activity of the spinal cord; it includes the movements of the limbs in walking, running, grasping, &c.

The second group depends upon the sensory ganglia at the base of the brain, and includes the closure of the lid when a bright light strikes the eye, the following of light with the eye, the shifting from an uncomfortable position; all of which may occur when the attention is completely absorbed by other ideas. These two groups may or may not be accompanied by consciousness.

The third group is *ideo-motor*, and depends on the cerebral hemispheres; including the various movements of features and limbs expressive of emotion; the shudder excited by some horrible story; the cries uttered in presence of some real or imagined danger. There are, however, involuntary cerebral processes which are ideal, but not motor, or which only issue in motion after a more or less lengthened interval. Such are the effortless successions of thoughts and feelings with which great part of our time is filled; such are those processes which represent the physical side of thought and feeling, but never pass the threshold of consciousness, and make themselves known only by their results. Dreams also, and the phenomena of somnambulism and hypnotism, belong to the ideal or the ideo-motor group. These last never indeed, or rarely, constitute organised habits in the sense in which walking, blinking, shuddering are habitual. But they always are the outcome of mental habits. For instance, the mathematician, who solved a problem in his sleep which he was unable to solve awake, certainly was not in the *habit* of solving that special problem. But he had a mathematical habit of mind; an organised mode of mental association which enabled him to strike into likely paths, and to do this all the better in the absence of the nervous tension caused by anxiety to succeed. So Coleridge uttered interminable monologues, and composed "Kubla Khan" in sleep, as the result of an

organic predisposition consolidated into habit—the habit of associating ideas metaphysically and poetically; aided, doubtless, by the other habit of taking opium.

This mention of opium leads us to the second great class of involuntary actions, which I shall call *impulsive*. These, too, may be divided into excito-motor, sensori-motor, and ideo-motor groups. They follow upon unusually strong internal or external stimuli, and are not necessarily connected in any way with habit, except in structures like the spinal cord, all of whose normal functions are automatic. For instance, when the foot is tickled, and the leg in consequence drawn up with some force, the action may either be said to be automatic or to be impulsive. But when, the cord having been stimulated by strychnia, the whole body is thrown into convulsions at a touch, then the movements are impulsive, although the special form they take is determined by automatism. Similar remarks may be made respecting unusually strong stimulation of the sensory organs. It is in ideo-motor actions that the contrast between automatism and impulse appears most strongly; although here, too, the path of an impulse, and its outward manifestations, may be determined by ingrained habit. Thus a similar emotion of anger may express itself in one individual by a blow or a stab, in another by a cutting phrase. Again, an impulse may clear a path, which remains open and initiates a new habit. It is a truism of moralists, that yielding to our passions weakens the moral nature; that is, makes it the prey of evil or exhausting habits.

From the effects of insanity and from the influence of various alcoholic and other stimulants are drawn the most striking examples of *impulsive* actions. The automatic powers are often heightened, the bodily and mental vigour seems for a time increased, and the superfluous though diseased and precarious energy overflows into new, or at least into unaccustomed channels. Frequently illusions occur, so vivid and so insistent as to hurry the insane or intoxicated person to extraordinary and often terrible deeds, of which in his normal condition he would be incapable, but which are now accomplished in spite of the strenuous efforts which he sometimes makes to desist from them. Of course the impulse must expend a force greater than that which is opposed to it by volition; but on the side of the conquered impulse the force is felt as *energy*, while on the side of the conquered volition it is felt as *effort*. It is true that when the impulse is not very strong, it can conquer volition only by a conscious effort; that is, by becoming itself in some degree volitional.

For there are degrees of volition, as there are degrees of consciousness. To the opposite case of volition being able to conquer impulse, I shall return later.

I have briefly sketched the two classes of involuntary actions. The first thing that will strike is that their union under the one order "involuntary" is, from a physiological point of view, very artificial. In the one class, we have a line of least resistance, which is either innate, or has been formed by repeated efforts or impulses, so that the least stimulus may set up a wave of nerve-energy, which, journeying along prepared channels, initiates a complex series of purposive movements. This series, however complex, is *predetermined*; that is, given the same stimulus, and the movements will be the same. Tickle the back of the throat, and there is a cough; bring a bright light suddenly near to the eye, and the lid will quickly close.

In the second class there is an unusually strong stimulus, which can either communicate increased energy to ordinary automatic actions, or can set up a molecular vibration so energetic that it travels along unaccustomed channels with irresistible force. The resulting movements are indeterminate; that is, they cannot be definitely predicted; and they may be purposive or wholly at random.

Although the two conditions—the prepared channel and the violent stimulus—frequently unite in the same action, and although their respective results are not always distinctly separable, still as *conditions* they have evidently nothing in common. Then, in both classes, we find actions of all grades—excito-motor, sensori-motor, ideo-motor, and also cerebral actions demanding intricate combinations of thought and of imagery. In but one respect all the grades of the two classes agree; they are not preceded by any conscious mental effort. In the one case, the want of effort is due to the easiness of the track; in the other, it is due to the energy of the stimulus.

(*To be continued.*)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(*Continued from page 43.*)

It is one of the difficulties of the task I have undertaken that new materials present themselves during the progress of the work, and sometimes disturb the chronological arrangement of the authors quoted. I had limited my examination of Withering's "Botanical Arrangement" to the first three

editions published in his life-time. But I have found it necessary to read through the fourth edition also, edited by his son, and published in 1801, two years after the author's death. This has yielded, among others, the following records:—

Cardamine pratensis, var. 2, double flowered, p. 568. In a field S.W. of the Tap House at Hagley. *This must be the plant referred to by Scott as Cardamine impatiens.*

Oenothera biennis, p. 361. In Worcestershire; Rev. Mr. Bourne. *This is included in Purton's list, on the same authority. The notice in Withering must take precedence of that in Purton, "Midland Flora," p. 195; "Midland Naturalist," Vol. X., p. 222.*

Saxifraga umbrosa, p. 394. In a sloping field a little below Moseley Common; Mr. W. Evans. *Must have been a garden escape.*

Angelica Archangelica, p. 293. Broadmoore, about 7 miles N.W. from Birmingham. *N.W. must be a mistake for S.W. A. Archangelica is not a British plant, and not naturalised in this country.*

* **Erigeron acre**, p. 703. Lime rocks, Dudley.

Previously mentioned by Dr. Sheward as growing on walls about Worcester Cathedral.

Hieracium sylvaticum, p. 671. (*H. vulgatum*. Fries.) Dudley Castle Hill. *This must take precedence of Perry's record.*

Euphorbia Characias, p. 443. On Malvern Hill, between the Inn and the Wells. *This is not a British plant, and not naturalised.*

Narcissus biflorus, p. 325. In fields near Yardley Wood Pool, Worcestershire, together with *N. Pseudo-narcissus*.

This must take precedence of the record in Scott.

Osmunda regalis, p. 747. This plant, though before not to be found for many miles around Birmingham, lately appeared on a butt on Moseley Common, artificially made with mud from a deep pit, in which the seeds had probably lain for a great length of time. It continued to flourish so long as the butt was permitted to remain, but has probably now again disappeared.

It will appear in the sequel that it existed at Moseley up to the enclosure of the Green in 1840, or about that time.

Cardamine pratensis and **Osmunda regalis** are new records. **Oenothera biennis** must take precedence of the record in Purton, **Hieracium sylvaticum** of the record by Perry, and **Narcissus biflorus** of the record in Scott.

In order to be sure that I have missed no other Worcestershire plants recorded by the Witherings, I have read through the seventh edition of the "Arrangement," that is, the fourth edition edited by the son, published in 1830. This contains many notices by Purton and other contemporary botanists, and, among others, a reference, Vol. II., p. 46, to the discovery of **Epipactis purpurata**, as recorded in the

“English Flora” of Sir James Edward Smith. The publication of this work in four vols., 8vo, was commenced in 1824. In the fourth volume, published in 1828, p. 41, we read as follows:—“*Epipactis purpurata*.—Parasitical on the stump of a maple or hazel, in a wood near the Noris Farm, at Leigh, Worcestershire, in 1807. Rev. Dr. Abbot. . . . ‘Root certainly parasitical. Whole plant, when fresh, glowing with a beautiful red lilac colour.’ . . . Stem about a foot high. . . . Whether my late friend, to whom I am obliged for my only specimen, found any more, I cannot tell, but I hope this account may lead to a further discovery of so curious and interesting a plant, which cannot be referred to any known species.”

It will be convenient to supply in this place some omissions made in the extracts from Purton’s *Midland Flora*; “*Midland Naturalist*,” pp. 221, 225, and pp. 255, 257.

Aristolochia Clematitis. Vol. II., p. 430. Foot note.—“This very rare and singular plant was discovered by Miss Mary Anne Rawlins, of Pophills, growing at Chaddesley, near Kidderminster.” This, although established in a few localities, is not a native plant, and Purton gives no explanation of the circumstances under which it was found.

The “Additions and Corrections,” forming part 2 of the 3rd volume of Purton, 1821, pp. 335—386, escaped my notice when examining the work of that author. The following is a list of them so far as they relate to the County of Worcester:—

* *Helleborus viridis*. Glasshampton; Mrs. Gardner.

H. foetidus. Southstone’s Rock; Mrs. Gardner. Hagley; Mr. Hickman.

* *Aquilegia vulgaris*. Near Lickhill; Hickman.

* *Brassica Napus*. Oldington; Hickman.

* *Cardamine amara*. Stourport, in a meadow of Mr. Worthington’s; Hickman. Wilden; Mrs. Gardner.

* *C. impatiens*. Areley Wood; Mrs. Gardner.

Thlaspi arvense. Lickhill; Hickman.

* *Dianthus deltoides*. Dunley; Mrs. Gardner.

* *Geranium phæum*. Cradley Park; Scott.

Euonymus europæus. Blackstone Rock, near Bewdley; Scott.

* *Lathyrus sylvestris*. Woods near Pershore; T. P.

* *L. Nissolia*. Glasshampton; Mrs. Gardner.

* *L. Aphaca*. Grove Coppice, near Stourport; Hickman.

* *Comarum palustre*. Hartlebury Common; Mrs. Gardner.

Rubus Idæus. In woods, abundantly, near Kidderminster; and in hedge rows, Chaddesley Corbet, &c.; T. P.

* *Geum rivale*. Abberley; Hickman.

Sorbus (Pyrus) Aucuparia. Near Bromsgrove Lickey, abundantly; T. P.

* *Parnassia palustris*. Feckenham Moors; T. P.

- * *Carduus acaulis*. Defford Common, between Pershore and Upton-on-Severn, abundantly ; T. P.
- * *Erigeron acre*. Sherrif's Lench ; Rufford.
- * *Campanula latifolia*. Dick Brook foot bridge, near Stourport ; Mrs. Gardner. Lincoln Wood ; Hickman.
- * *C. patula*. Glasshampton ; Hickman. Hartlebury ; Mrs. Gardner.
- * *Pyrola media*. Cradley Park, near Stourbridge ; Scott.
- * *Chironia (Erythræa) Centaurium*. Flore albo. Near Dudley, Worcestershire ; Bree.
- * *Gentiana Amarella*. Woodbury Hill ; Mrs. Gardner.
- * *Menyanthes trifoliata*. Wilden ; Hanley Common ; Hickman.
- * *Antirrhinum Orontium*. Lower Areley, near Bewdley ; Mrs. Gardner.
- Linaria minor*. Broadway Hills ; Rufford.
- Lathræa squamaria*. Abberley ; Mrs. Gardner.
- Scutellaria minor*. Hanley Common ; Hickman.
- * *Lysimachia vulgaris*. Hampstall ; Mrs. Gardner.
- * *Butomus umbellatus*. Between Stourport Bridge and Lickhill ; Mrs. Gardner.
- Orchis ustulata*. Abberley ; Mrs. Gardner.
- * *Ophrys apifera*. Abberley ; Mrs. Gardner. Eastham, near Tenbury ; Rev. Mr. Whitehead.
- * *Serapias (Cephalanthera) ensifolia*. Abberley Hill ; Mrs. Gardner.
- * *Galanthus nivalis*. Astley Wood, near Stourport ; Hickman.
- * *Convallaria majalis*. Abundantly in Shrawley Woods ; Hickman.

Of the 37 plants in this list, the following ten are new records :—

Helleborus fœtidus Mrs. Gardner. Mr. Hickman.

Thlaspi arvense. Hickman.

Euonymus europæus. Scott.

Linaria minor. Rufford.

Rubus Idæus. T. Purton.

Lathræa squamaria. Mrs. Gardner.

Pyrus Aucuparia. T. Purton.

Scutellaria minor. Hickman.

Pyrola media. Scott.

Orchis ustulata. Mrs. Gardner.

Thlaspi arvense and *Scutellaria minor* take precedence of Perry's records, 1831 ; *Euonymus europæus*, *Rubus Idæus*, and *Pyrola media* are earlier records by Scott than those in the "History of Stourbridge," 1832 ; *Pyrus Aucuparia* and *Lathræa squamaria* take precedence of Edwin Lees's records in Loudon, 1830 ; *Orchis ustulata* takes precedence of the record in Mary Southall's Description of Malvern, 1825.

The late Mr. Edwin Lees in the introductory remarks to his catalogue of Worcestershire plants, contributed to the "Illustrations of the Natural History of Worcestershire," by the late Mr. Charles Hastings, M.D. (1834), to be described hereafter, has given a list of the principal works in which notices of Worcestershire plants were to be found up to that date. Those which have not been already referred to in these pages are the following :—

Laird's Topography of Worcestershire in the "Beauties of England and Wales."

“Walford’s Scientific Tourist through Great Britain.”

Florence’s “Worcester Guide.”

Dr. Booker’s “History of Dudley.”

“The Midland Medical and Surgical Reporter.”

No dates are given to any of these works.

The account of Worcestershire, by F. C. Laird, is contained in Vol. XV. of the “Beauties of England and Wales,” 1814. It contains three lists of plants: those of the neighbourhood of Malvern, at p. 322; of the neighbourhood of Pershore, at p. 359; of Bredon Hill, at p. 365. With the exception of *Clematis Vitalba*, previously noted by Pitt, all the species are taken, without acknowledgment, from the first catalogue of Dr. Nash.

I have not seen Walford’s “Scientific Tourist through Great Britain.” I am indebted to my friend, Mr. F. E. Blackstone, of the British Museum, for a description of it, and for extracting the list of Worcester plants. The work was published, in two vols., in 1818. The Worcester list comes last in Vol. I. It contains 41 “rare plants,” most of them discovered by Nash, Stokes, or Withering, and was probably taken from one of the later editions of the “Botanical Arrangement” of the latter author. It contains no original matter and no new records.

“A Descriptive and Historical Account of Dudley Castle and its surrounding scenery,” by the Rev. Luke Booker, LL.D., vicar of Dudley, was published at Dudley in 1825. It contains, at p. 107, “A List of Plants, &c., growing (many of them indigenously) near the Castle,” and is interesting as the first collected record of the plants of the Castle Hill. I therefore give the list entire, re-arranged in accordance with modern sequence:—

- | | | |
|-----------------------------------|---|-----------------------|
| <i>Anemone nemorosa</i> . | * <i>Chlora perfoliata</i> . | |
| * <i>Reseda Luteola</i> . | * <i>Solanum Dulcamara</i> . | |
| <i>Linum catharticum</i> . | * <i>Atropa Belladonna</i> . | |
| <i>Geranium dissectum</i> . | * <i>Thymus Serpyllum</i> . | |
| * <i>G. (Erodium) moschatum</i> . | * <i>Melissa Calamintha</i> . | |
| <i>Alchemilla vulgaris</i> . | * <i>Echium vulgare</i> . | |
| <i>Rosa villosa</i> . | <i>Plantago media</i> (var. <i>foliosa</i>). | |
| <i>R. canina</i> . | * <i>Ulmus campestris</i> . | } <i>One species.</i> |
| <i>R. arvensis</i> . | <i>U. suberosa</i> . | |
| <i>Cratægus Oxyacantha</i> . | <i>U. glabra</i> . | |
| <i>Pimpinella Saxifraga</i> . | <i>U. montana</i> . | |
| * <i>Carduus eriophorus</i> . | * <i>Paris quadrifolia</i> . | |
| * <i>Conyza squarrosa</i> . | * <i>Colchicum autumnale</i> . | |
| * <i>Erigeron acre</i> . | <i>Avena elatior</i> . | |
| <i>Fraxinus excelsior</i> . | | |

Of the 27 plants in the above list, 13 are new records. Two of them, viz., *Alchemilla vulgaris* and *Rosa villosa*, take precedence of the records in Mr. Edwin Lees's list of Malvern plants in "Loudon's Magazine;" and three of them, viz., *Linum catharticum*, *Plantago media*, and *Avena elatior* take precedence of the same plants in Scott.

(To be continued.)

TWENTY-NINTH ANNUAL REPORT
OF THE
BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL
SOCIETY,

PRESENTED BY THE COUNCIL TO THE ANNUAL MEETING,
FEBRUARY 1ST, 1888.

The Society has worked during the past year, 1887, under the new arrangement of sections, the four sections—Microscopical, Biological, Geological, and Sociological—meeting on the four successive Tuesdays in each month, and this arrangement has been found satisfactory and successful. The particulars of the papers read at the meetings are given under the heads of the different sections, and several of these papers have been of much interest and value, and have well sustained the character of the Society.

A conversazione was held on October 4th, at the opening of the session, and proved very successful. It was held in the Examination Hall, Mason College, and a fine collection of zoological, botanical, and geological specimens was contributed from the College Museums. An interesting collection of birds and their nests was exhibited by Mr. Chase; a large collection of fungi by Mr. Grove; and an extensive series of glass photographs by Mr. Pumphrey and Mr. Watson; also a number of objects under microscopes. The conversazione gave great satisfaction, and from the liberality of friends the cost to the Society was very small.

An excursion to Oxford was carried out on Whit Monday, when the members were very kindly received by Mr. Druce and Mr. Simms and the several College authorities, and had a very interesting and agreeable review of the college buildings and gardens, and of the Botanic Gardens, over which the members were conducted by Professor Balfour.

The annual meeting of the Midland Union of Natural History Societies was held at Malvern, on July 6th and 7th, where excursions were made to the Syenitic Quarries of the North Hill, the Upper Llandovery Sandstone at the Wyche, the British Camp, and Ledbury Church; and the fine Silurian and Old Red collection of Mr. G. H. Piper was seen.

The annual financial statement of the treasurer shows the total receipts for the year, £249 2s. 11½d., the total payments (including adverse balance of £17 19s. 1½d. last year), £251 0s. 5½d., leaving a balance due to the treasurer of £1 17s. 6d. The receipts for the year from subscriptions have covered the current expenditure of the year, showing that the Society is in a sound working position; but there was, at the commencement of the year, a considerable amount of arrears owing for rent and for publication of proceedings, as well as the balance due to the treasurer, and for the purpose of clearing off these arrears six loans of £10 each have been granted by some members of council, and after paying all accounts due at the end of the year, the two sides of the account are now practically balanced.

The council have provided for paying off these loans by effecting a reduction in the expenditure, dispensing with the assistant curator and librarian, and discontinuing for the present the daily opening of the Society's room, by discontinuing expenditure upon the library, and suspending the supply of the expensive serial publications. It has been with great reluctance and regret that the council have taken this step, but they felt bound not to let the Society remain in debt, and not to incur any current expenditure that could possibly be avoided until that object is accomplished. They look with confidence to the speedy restoration of these temporary suspensions, and they appeal earnestly to the members to assist in hastening that time by obtaining additions to the number of members, and so increasing the income of the Society.

The total number of members for the year 1887 is 208, being 7 less than the previous year. There are 7 life members, 152 ordinary (guinea) members, 13 family (half-guinea) members, 5 honorary vice-presidents, 27 corresponding members, and 4 associates.

The council have deep regret in recording the loss, during the year, of Mr. Thomas Bolton, F.R.M.S., whose lamented death has been widely felt. He was for many years a very active and valued member of the Society, and has been of late years acting as the assistant curator and librarian. Shortly before his death, a wish was expressed that his services to the Society should be recognised by making him a life member, but, his death intervening, this distinction has been conferred instead upon his son, Mr. Thomas E. Bolton.

A fine set of microscopical slides of polycystina and diatomaceæ, from the celebrated Barbados earth, has been presented to the Society by Professor Hamilton, of the Government Laboratory, Barbados. A cabinet for 1,000

microscopical slides has been presented to the Society by Mr. William Morley, as a memorial of his late brother, Mr. John Morley, who was for so many years the active honorary secretary of the Society.

An important question that has been recently occupying the attention of the council is a proposal for amalgamation of this Society with the Birmingham Philosophical Society. This has been discussed by a joint committee of the two Societies, and is still under the consideration of the respective councils.

MICROSCOPICAL SECTION (*Ex-officio*: President, Prof. W. Hillhouse, M.A., F.L.S.; Secretary, W. H. Wilkinson).—During the year nine meetings of the section have been held, with an average attendance of fifteen; and the following communications have been made:—

March 1st.—Measurement of magnifying power of microscopic objectives, with exhibition of his new $\frac{1}{25}$ in. objective: W. P. MARSHALL, M.I.C.E.

April 5th.—Colour-reaction, its use to the microscopist and to the biologist, with experiments: W. H. WILKINSON.

May 3rd.—The anatomy of rotifers, illustrated by living specimens and coloured drawings: T. BOLTON, F.R.M.S.

June 7th.—Devitrification of volcanic glasses, with specimens and sections: T. H. WALLER, B.A., B.Sc.

November 1st.—Photo-micrography, with practical illustrations: J. EDMONDS.

Mr. W. P. Marshall showed his new $\frac{1}{25}$ in. objective at two meetings of the section, showing how to work with powers of such high magnification, and affording the members the opportunity of seeing any of their own specimens under higher powers than are usually accessible; Mr. W. B. Grove exhibited fungi preserved by the process of Mr. English, by plaster of Paris, and a preservative solution; Mr. T. Bolton exhibited a number of specimens of minute fresh-water life, especially rotifers, many of which were rare, and some new to science; Mr. Horace Pearce exhibited a collection of rocks from the Lake district; and Mr. W. H. Wilkinson, a number of lichens and plants.

BIOLOGICAL SECTION (President, R. W. Chase; Secretary, W. P. Marshall).—During the year eleven meetings of the section were held, with an average attendance of seventeen members, and the following papers have been read at the meetings:—

February 8th.—South American and European mosses, with micro-preparations: J. E. BAGNALL, A.L.S.

March 8th.—Micro-fungi, illustrated by coloured lantern slides: REV. H. FRIEND, F.L.S.

April 15th.—Phosphorescence in the animal kingdom: A. B. BADGER.

May 10th.—Third eye in *Anguis fragilis*, the slow-worm: H. J. CARTER, F.R.S.

June 14th.—Investigations into the function of tannin in the vegetable kingdom: PROFESSOR HILLHOUSE, M.A., F.L.S.

July 12th.—British plants now growing in his "Wild Garden" at Shrewsbury: HORACE PEARCE, F.L.S., F.G.S.

October 11th.—Dredging excursion to Puffin Island at the recent British Association meeting: W. P. MARSHALL, M.I.C.E.

December 13th.—*Hyalonema lusitanicum*, the glass-rope sponge: W. R. HUGHES, F.L.S.

Three supplementary meetings have also been held for the "Study of Mosses and their Life History," conducted by Professor Hillhouse and Mr. Bagnall; and it is desirable for such a proceeding to be carried out in other branches of biology.

Extensive collections of fungi, including several new species, have been exhibited by Mr. Grove; numerous specimens of mosses and lichens by Mr. Bagnall and Mr. Wilkinson; and a fine series of diagrams, illustrating the structure of sponges, was exhibited by Mr. Hughes. An improvement in the new surface tow-net, used in the former Tenby excursion, was exhibited in connection with the paper on the "Puffin Island Excursion."

GEOLOGICAL SECTION (President, T. H. Waller, B.A., B.Sc.; Secretary, J. Udall, F.G.S.)—Ten meetings of this section have been held during the year, with an average attendance of eighteen members. The section is pleased to acknowledge its continued obligations to the chairman for several valuable papers during the session, and the exhibition of many rock sections, and experiments in illustration of his papers. Special mention should also be made of the valuable aid rendered by Mr. C. Pumphrey in illustrating various papers by the oxy-hydrogen lantern. The following communications were made to the section:—

February 22nd.—Photographic Views in Switzerland (taken during a holiday tour by Mr. C. J. Watson), were shown with oxy-hydrogen lantern, by MR. C. PUMPHREY. MR. C. J. WATSON described each view as it was projected on the screen.

March 15th.—Paper by PROFESSOR HILLHOUSE: "On the Distribution of Plants in Time."

April 19th.—Note on "Occurrence of Gold at Mount Morgan, near Rockhampton, Queensland," by MR. JOHN H. LLOYD, M.A.
A paper by MR. A. H. COCKS on "Chillingham Wild Cattle."

May 19th.—Paper by MR. W. P. MARSHALL on "The recent Riviera Earthquake," with particulars from eye-witnesses. At the close of the paper, Mr. Evans (a visitor introduced by Mr. Walliker), who was present at Mentone during the earthquake, gave a graphic and dramatic account of his experience of the earthquake and its effects.

July 19th.—Note by MR. WALLER on the "Remarkable and Unique Geology of Skye and the surrounding district."

August 16th.—Note by MR. HORACE PEARCE, F.G.S., on "Silver-bearing Rocks from the Rocky Mountains."

October 18th.—Paper by MR. WALLER on “The Micro-chemical Methods for the Examination of Minerals,” illustrated by (1) Experiments in Flame-colouration; (2) Solutions of Minerals placed under microscope.

November 15th.—Paper by MR. W. PUMPHREY on “The recent Disaster on Lake Zug,” illustrated by photograph and ground plan.

SOCIOLOGICAL SECTION (President, W. R. Hughes, F.L.S.; Secretary, F. J. Cullis, F.G.S.).—The work of the section has been steadily maintained throughout the year, a total of twenty-five meetings having been held; ten of which were ordinary meetings, thirteen supplementary meetings, and two excursions; the average attendance being twelve. At the October meeting, the President delivered his address on the Recent Literature of Evolution. The other meetings were devoted to the study of Mr. Herbert Spencer’s “Data of Ethics,” papers being read as follows:—

February 22nd.—Introductory Paper, by MISS NADEN.

March 22nd.—On the Evolution of Conduct: MR. F. J. CULLIS.

April 26th.—On the Physical and Biological Views of Conduct: MR. W. R. HUGHES.

May 24th.—On the Psychological and Sociological Views of Conduct: MR. W. R. HUGHES.

June 28th.—Criticisms and General Review: MR. A. BROWETT.

November 22nd.—On the Relativity of Pains and Pleasures: MR. W. B. GROVE, B.A.

The supplementary meetings were held on the first and third Thursdays of the months, tea being served at 5.30, after which the following papers were read:—

March 3rd.—On Mr. Herbert Spencer’s “Factors of Organic Evolution:” MR. A. BROWETT.

March 17th.—On Ditto, ditto, ditto: MR. A. BROWETT.

April 7th.—On Ditto, ditto, ditto: MISS BYETT.

April 21st.—On Ditto, ditto, ditto: MR. F. J. CULLIS.

May 5th.—On “Complexion in relation to Offspring:” MR. W. H. FRANCE.

May 19th.—On Mr. Herbert Spencer’s essay on “Use and Beauty:” MRS. BROWETT.

June 2nd.—On Mr. Herbert Spencer’s essay on “Manners and Fashion:” MISS DALTON.

June 16th.—On Individualism in Art: MR. W. K. PARKES.

June 30th.—On Mr. Herbert Spencer’s essay on “Manners and Fashion:” MISS DALTON.

November 3rd.—On Mr. Herbert Spencer’s essay on “The Classification of the Sciences:” MR. F. J. CULLIS.

November 17th.—On Ditto, ditto, ditto: MR. F. J. CULLIS.

December 1st.—On Mr. Herbert Spencer’s essay on “The Philosophy of Style:” MISS DALTON.

December 15th.—On Mr. Herbert Spencer’s essay on “The Genesis of Science:” MR. W. K. PARKES.

On Saturday, July 23rd, the members and friends of the section made their ninth excursion, this being to Hartshill, as “Michael Drayton’s Country.” After a pleasant ramble, Dr. Showell Rogers read a very able paper on “Michael

Drayton and his Works.” The tenth excursion of the section was made on December 17th, this being confined to places in Birmingham—as “Dr. Priestley’s Country.” There was afterwards exhibited in the Society’s room, through the kindness of Sam: Timmins, Esq., F.R.S.L., and Mr. W. H. Cope, a large and interesting collection of Dr. Priestley’s books, engravings, and autograph letters. A sympathetic and eloquent address on “Priestley” was also delivered by Dr. Crosskey, the able and courteous successor to his pulpit.

Miss Naden’s introduction to the study of the “Data of Ethics” and Mr. W. K. Parkes’s essay on “Individualism in Art” have been published in the “Midland Naturalist.” The section has suffered a great loss in the removal of Miss Naden from Birmingham.

The Library.—The librarian (J. E. Bagnall, A.L.S.) reports favourably as to the state of the Library. The issue of books has been as follows: Botany, 52; Zoology, 22; Ornithology, 5; Entomology, 3; Geology, 20; Microscopy, 20; Philosophy and General, 59; total, 181, being 36 in excess of last year. The number of persons borrowing books during the year has been 38, as against 41 in the previous year. The list of books added to the Library during the year will be separately published.

General Property.—The curators (G. M. Iliff and H. Miller) have to report that the microscopes are now in good order, the necessary repairs having been effected during the year. The parabolic illuminator belonging to the Swift microscope, mentioned as missing in the last year’s report, has been found and replaced in its case.

NOTES ON THE WARWICKSHIRE STOUR VALLEY AND ITS FLORA.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 28.)

THE RIVER STOUR AND ITS AFFLUENTS.

The Stour rises at Stour Well, near Tadmarton Camp, in Oxfordshire, and enters Warwickshire at Traitor’s Ford, three miles west of its source. Here it is a rapid but insignificant stream, and its course is west and north-west, through Stourton and Cherrington to Mitford Bridge, receiving small feeders on right and left bank, near Whichford Mill; on its right bank at Stourton it joins, or, better, takes the bed of Sutton Brook, a stream rising near Compton Wynyates, and flowing through Lower Brailes and Sutton-under-Brailes.

At Mitford Bridge it is fed by another tributary, Nethercote Brook, which stream rises on the west slopes of the Oxfordshire boundary, about a mile south of Traitor's Ford, and at an elevation of 420 feet. It is fed by numerous streams rising on the slopes of Bright Hill, and has, for some distance, a course nearly parallel with the Stour. Its course is west for about four miles, through Long Compton and north of Barton-on-the-Heath; here it is joined by Stamford Brook, and its course becomes northerly for about three miles to Mitford Bridge, joining the Stour on its left bank, having received near this a stream from Wolford Wood and the surrounding district. The Stour now flows northward by Burmington Mill; near this place joined by Knee Brook, which rises on the eastern slopes of Ebbrington and Knowlands Hill, and drains a wide extent of country; and a little further north a small stream from Brailes Hill enters the Stour at its right bank.

From this point the Stour flows north through Barcheston, Shipston-on-Stour, Honington Park, and Tredington. Here it receives, on its right bank, another important tributary. This stream is formed by a confluence of streams, the main one rising at Brome Hill, at an elevation of about 700 feet, about three miles north of Traitor's Ford. This flows north-west by Tysoe, through Oxhill, where it is augmented by a small feeder rising on Tysoe Hill; the united streams flowing on to Whatcote Bridge, where they are further augmented by a stream rising at Compton Wynyates. The united stream flows west towards Halford, and taking a sudden turn south, flows into the Stour near Tredington Mill, where the river bed has an elevation of about 180 feet, the whole course being about nine miles. About this part of the district the country lies low, and floods are not unfrequent in rainy seasons.

The Stour continues a north-west course by Halford Bridge, through Lower Easington Park and Upthorpe to Wimpstone; here it receives a small feeder, Humber Brook, rising on the northern slopes of Ilmington Hill. From this point it passes through the beautiful park at Preston-on-Stour, through Atherstone-on-Stour and Clifford Chambers, to its confluence with the Avon near Milecote. Its total course is about nineteen miles, its fall being from 365 feet at Traitor's Ford to 110 feet at its confluence with the Avon.

In endeavouring to give some account of what has been recorded from this district, it is scarcely needful that I should state that most of the plants I shall mention have been found and recorded by Mr. Newbould, others by the Rev. James Gorle, of Whatcote, and some by F. Townsend, Esq., of

Honington Hall. I have felt it would be tedious to be constantly mentioning these names in connection with the plants I notice. I have invariably given each of my kind correspondents the full credit of their work in my "Flora of Warwickshire," which I am hoping shortly to publish.

The whole district of the Stour is well-wooded. This not only gives a special charm to the district, but as the hedge-row trees are frequently clothed with abundant mosses, scale mosses, and lichens, the eyes and mind are kept fully occupied looking for these minuter treasures, rendering a walk through this district one of never-failing interest. The ash and elm are abundant, and from these I have gathered rich harvests of cryptogamic wealth, such as *Orthotrichum obtusifolium*, which occurs at Tysoe, Brailes, and Ilmington. *O. tenellum* and *O. stramineum*, which occur at Wimpstone. *Cryphæa heteromalla*, a rare plant usually in Warwickshire, is frequent in this valley. *Tortula lævipila*, *T. papillosa*, and *T. latifolia* are not unfrequent, the two latter being in abundance at Wimpstone. *Zygodon viridissimus*, *Leucodon sciuroides*, and *Orthotrichum affine* are abundant. *Anomodon viticulosus* occurs at Wimpstone. *Weissia cirrhata*, usually frequent in the county, is rare in this valley, but I have it from Ilmington. Of Hepatics, I have found few that were more than local. *Radula complanata*, *Porella platycarpa*, and *Aneurina sinuata* occur, but the most constant species is the common *Frullania dilatata*.

Spinneys, coppices, and small woods are frequent, but are somewhat disappointing. In one at Ilmington, however, I noticed abundance of *Equisetum maximum*. In Honington Park *Vinca minor* is quite established and abundant, and near Pillerton Lazer, which is the extreme northern limit of the district, I noticed *Epipactis latifolia* and *Listera orata*. But there are also large woods, such as those at Whichford, Long Compton, Weston, Barton-on-the-Heath, and Great and Little Wolford. Each of these I have visited, but in many cases too hurriedly to form any opinion as to their flora. A wood requires close investigation, plenty of time, and permission to roam at will through all parts. The woods here are usually closely preserved, and are often very difficult of access, hence my records from these haunts of our wild flowers will be poor. *Stellaria umbrosa* occurs near Great Wolford, *Dipsacus pilosus* and *Arctium nemorosum* were pointed out at Honington, *Primula caulescens* and *P. intermedia* being also recorded from the same locality. *Rubus idæus*, rare in this district, I noticed near Brome Hill and Tysoe; *Lysimachia Nummularia* at Wimpstone, and *Lithospermum officinale* from Lower Eating-

ton. Ferns are remarkably rare in this valley. I have, however, seen *Lastrea filix-mas* var. *Borreri*, *L. spinulosa*, *L. dilatata*, *Athyrium filix-femina*, and the fine variety *rhaeticum* at Great Wolford and Barton-on-the-Heath. Of woodland mosses, the more rare are *Hypnum brevirostre*, *H. piliferum*, *H. striatum*, *Orthotrichum Lyellii* in fruit, *Polytrichum attenuatum*, *Pogonatum aloides*, and *Scapania nemorosa*, all from Wolford Wood.

Fields and pastures are always inviting, and few districts are more convenient to the botanist for a thorough exploration of these places than this Stour Valley, for here bridle roads and footways are a prevailing feature. Little that is really rare has at present been noticed, but of the more noteworthy the following may be mentioned:—*Papaver lecoqi*, *Senebiera coronopus*, *Lychnis segetum*, and *Saxifraga granulata* are all recorded from near Honington. All these are rare in the district:—*Valerianella dentata*, *Picris hieracioides*, *P. echioides*, *Linaria spuria*, *L. elatine*, *L. viscida*, *Galeopsis ladanum*, *G. speciosa*, *Chenopodium polyspermum*, and *Orchis morio* were also all found near Honington, Lambcote, and Halford, but I have not seen them elsewhere in this valley. *Brassica nigra* and *B. alba* occur near Great Wolford. *Thlaspi arvense*, usually abundant in Lias soils, occurred as a single specimen at Wimpstone. *Rhaphanus raphanistrum* was very abundant at Tysoe, and here, also, I saw for the first time *Chrysanthemum segetum*. *Alchemilla vulgaris* I have not seen, but Mr. Gorle records it from Idlicote; and the rare *Spiræa filipendula* is recorded by Mr. Townsend from Armscote, one of the few places in this district that I have not seen.

The roads and lanes of a district are often specially interesting, and not unfrequently afford the botanist a better idea of what has been the prevailing flora of the district than he could gain from either woods, pastures, or fields. They are always of special interest to me, for it was in the lanes I took my first lessons in botany, and often still I linger by the banks redolent of violets, or bright with cheery speedwell, and look with the same old enthusiasm for the first primrose, or search the neglected wayside, among wavy ranks of poa and fescue and dogstail, or squat plantain, and sand-wort for some rarer and more prized weed. But in this district the wayside flora is poor, and mile after mile may be travelled with only an ever-recurring repetition of the same plants; whilst I do not remember to have found more than one or two of the rarer plants, I have found several that are local in other parts of the county. *Ranunculus auricomus*, and *Viola Reichenbachiana*, *V. hirta*, and *V. odorata* occur about Great Wolford, Honing-

ton, Idlicote, and Easington. *Malva rotundifolia*, Shipston-on-Stour and Honington. *M. moschata* is not unfrequent. *Hypericum hirsutum* is widely spread, but *H. pulchrum* I have only seen growing with *Senecio sylvaticus*, *Hieracium boreale*, and *Aira flexuosa* on Compton Warren, near Tysoe. *Geranium pyrenaicum* occurs as a casual near Honington. *G. pratense* and *Melilotus officinalis* are frequent, whilst *M. arvensis* is merely a casual at Tysoe and Oxhill. *Trifolium medium*, *T. striatum*, and *T. filiforme* are recorded from Honington only. *T. hybridum* is occasional on field borders, a mere remains. *Anthyllis vulneraria* and the pretty *T. fragiferum* occur at Easington, Honington, and Whatcote, but *Lathyrus nissolia* is only recorded from Honington, and I have only once seen *L. machrorrhizus*, near Great Wolford. *Conium maculatum*, *Sison amomum*, *Silene pratensis*, and *Centaurea scabiosa* are somewhat frequent. *Carum segetum* and *Adoxa moschatellina* I have not seen; both are recorded from Honington. *Galium mollugo* I have seen at Halford and Wolford. *Carlina vulgaris* on some moorish land near Wimpstone. *Serratula tinctoria* near Brailes. *Inula conyza* at Atherstone-on-Stour and Whatcote. *Arctium majus* Honington and Brailes. *Carduus nutans* Compton Warren, Tysoe, and Wimpstone. *C. eriophorus* on Bright Hill. *Taraxacum erythrospermum* near Ilmington, whilst *Carduus crispus* and the rayed form of *Centaurea nigra* are not unfrequent. *Lamium galeobdolon*, frequent in North Warwickshire, is rare here; I have only seen it at Barton-on-the-Heath. *Nepeta Cataria* at Lambcote and Atherstone-on-Stour. *Bromus erectus* and *Brachypodium pinnatum* at Easington and Barton-on-the-Heath. *Orchis incarnata* and *O. latifolia* Mr. Newbould showed me from marshy land near Halford. *Avena pratensis* and *Verbena officinalis* occur at Tredington, just over the county boundary; and *Blackstonia perfoliata* is recorded by Mr. Townsend from near Admington.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Continued from page 40.)

CONTROL OVER THE PURITY.—The first and most persistent opposition to this scheme of water supply arose from the idea that the water might be made impure by the construction of similar dumb-wells for the disposition of sewage or other objectionable matter, as there was no legal control over

underground waters. It was pointed out that an outlying district of Northampton—St. James' End—at that time in considerable difficulty as to the disposal of its sewage, might construct dumb-wells, reaching to the Marlstone, and get rid of it by means of them, and thus contaminate the water supply of the town. As it was then generally thought there was no legal power to prevent this, I could only answer such objections by pointing out that it was not probable the authorities at St. James' End would try a scheme which it was impossible could work satisfactorily for them; for one such well would rapidly silt up, with the solid matter carried into it, to above the water-bearing bed, and then not even the liquid portion would be got rid of. Fortunately there is now little fear that such a plan will be tried here or elsewhere in the country, for it has been decided in a very emphatic manner that although the owner of a well has a perfect right to all the water he can obtain from it, as it exists in nature, he must not deny that right to others by polluting the common source. The case is so important that it cannot be too well known; hence I have given a summary of the contention and decision below.

* About forty years ago two deep wells, with borings, were made at Brentford, one at a brewery, the other at a distillery. They both passed through Gravel, London Clay, and the Lower London Tertiaries into the Chalk, the last named being met with at a depth of rather over 300ft. The two wells are 99yds. apart, and when the distillery ceased to exist, and the premises were converted into printing works, the well there was used as a cess-pit, with the result that the other well became considerably contaminated, and of course continued to be so when the disuse of the first named well was stopped. This condition of matters led to an action by Mr. Ballard against the owner of the distillery well, Mr. Tomlinson, for heavy damages. There was absolute proof of communication between the two wells, and so the decision for defendant given by Mr. Justice Pearson, in February, 1884, was entirely based on his interpretation of the law, he holding that the plaintiff had no greater right with respect to the quality of the water than he had with regard to the quantity, that he must take the water as he found it, both in quantity and quality, the decision

* From a pamphlet by Mr. W. Whitaker, B.A., F.G.S., &c., on "A recent Legal Decision of importance in connection with Water Supply from Wells." Report of paper read September 25, 1885, at Congress of the Sanitary Institute of Great Britain. See also "Justice of the Peace" for February 21, 1885.

being based upon a well-known case, "Chasemere v. Richards." The case was then taken to the Court of Appeal, and the previous decision unanimously overruled by the Master of the Rolls and Lords Justices Cotton and Lindley, in February, 1885. The reasons assigned for this were to the effect that an owner of property has no ownership over the water percolating below the surface of the ground, though he has a right to appropriate as much as he likes during its passage under his land, even to the extent of taking it all, but he must not pollute the common reservoir or source so as to affect the right of his neighbours to appropriate the water in its natural state. In answer to an argument on behalf of defendant to the effect that if the plaintiff had not by artificial means pumped up the water he would not have sustained damage, so that the damage would not have accrued but for his own act, it was replied that "as long as a person did not use means which were unlawful, however artificial or extensive those means might be, he had a right to use them."

It must be a great relief to authorities deriving their water supply from underground sources of moderate depth to know that they can stop pollution of the reservoir, even though the source of the pollution may be a considerable distance away, and particularly in cases where the porous bed is of considerable thickness, and so would not easily bring about its own prohibition of disuse by silting up.

THE PURIFICATION OF WATER.

There is so much difference of opinion with respect to what constitutes a safe water for drinking purposes, and as to the adequacy of natural and artificial means of purification, that I venture to submit the following notes on the subject, and then the sufficiency or otherwise of the precautions suggested in connection with the filling up of the Marlstone may be judged.

The impurities in a water may be derived from the atmosphere through which it passes as rain, the soil through or over which it runs, the rocks or deposits in which it is collected, and the sewage or other matter discharged into it,

. RAIN WATER, which indeed all fresh water is in the first instance, has had less opportunity of becoming polluted than any other water; but even this is seldom satisfactory for drinking purposes unless collected far away from towns. Analysis of samples of rain from various parts of the country, made for the Rivers Pollution Commission, show that it is water that has washed a *dirty atmosphere*, full of the products of respiration of animal life, and of animal and vegetable

waste and decay, and zymotic germs, together with the fumes of manufacturing processes. These various substances hang suspended in the air, and may be carried long distances by the wind until condensation of moisture takes place, and then they are entangled in the minute globules of water forming clouds, and are so brought down with the rain.

Half-a-pint of rain water often condenses out of 3,373 cubic feet of air, the quantity of air a man would breathe in eight days, so that in drinking that quantity he swallows an amount of impurity that would only reach his lungs from the air in eight days.*

However unsuited ordinary rain water may be for drinking, it is very valuable for washing, owing to its softness, and therefore the small amount of soap required for detergent purposes compared with that required by hard waters.

If then rain water is so impure, and at the first contact with the ground it usually becomes much more so, it is evident that some highly-efficient purifying processes are at work to enable us to have any water to which the term pure may be applied. By carefully considering the way in which alone this purification is accomplished naturally, viz., by oxidation and filtration during the passage of the water through soil and rock, and the amount of it which around Northampton gives a reputedly pure spring water, the efficiency of the various arrangements proposed for filling up the Marlstone will be very evident.

A PURE WATER is never met with naturally, but a water is usually regarded as pure that is free from all those substances that can be injurious to persons drinking it. It may contain impurities that are objectionable for other household, or for manufacturing purposes, some of which may and others may not be removed by artificial processes, save that of distillation.

HARD AND SOFT WATERS.—Of good waters, some are hard and some soft, *i.e.*, some destroy much soap in the process of washing, others little; and the hardness may be temporary or permanent.

Temporary hardness is due to the presence of the carbonates of lime or magnesia in the water. Perfectly pure water will not dissolve much of these substances, only about two grains to the gallon (70,000 grains) of the most common one of the two—carbonate of lime; but water containing carbonic acid, as all rain and most other water does, will dissolve more of these carbonates in proportion to the amount of acid (carbonic

* Sixth Report of Rivers Pollution Commission.

acid gas dissolved in water) present. The soluble substance formed by the action of carbonic acid on a carbonate is usually called a bicarbonate. On boiling the water, any carbonic acid gas present is slowly driven off, and the carbonates of lime or magnesia previously dissolved by it thrown down as a precipitate—the fur of the tea kettle, and the incrustation of the steam boiler—and the water is to that extent softened; hence the term “*temporary*” to hardness arising from the presence of carbonates. A process adopted on a larger scale for softening water is that known as Clark’s process; it is carried out by adding a sufficient amount of lime to the water to take up all the carbonic acid gas present. The two substances form carbonate of lime, which is thrown down, together with the carbonates previously dissolved by aid of the carbonic acid now otherwise engaged.

Permanent hardness is due chiefly to the presence of the sulphates of lime and magnesia in water, and in this case also it is the lime salt that is most commonly present. There being no workable process for removing the sulphates from water, the hardness arising from their presence is termed *permanent*. Chloride of calcium may sometimes contribute to the permanent hardness.

The total solid residue obtained on evaporating a water may be made up of a number of substances, only part of which give to water the property of hardness. The others may or may not indirectly contribute to the hardness, or be injurious themselves.

The question of hardness and total solids deserves some little consideration, because the Marlstone water is certainly rather hard, and that previously supplied to the town always contained about fifty grains of solid matter per gallon, an amount which it is usually considered should not be exceeded in a good drinking water.* From my own observations I have no doubt that the water was good and wholesome, and not injurious to the public health, though one or two instances came under my notice where the water appeared to produce some derangement of the digestion with persons using it, for the symptoms ceased when they boiled the water before drinking. The general opinion appears to be that within considerable limits there is no difference between hard and soft waters as regards health, and that habit has a great deal to do with the matter; a change from one kind of water to

* For a considerable amount of evidence on this and other similar matters by Doctors Frankland, Lyon Playfair, Parkes, Miller, &c., see “National Water Supply,” a pamphlet published by the Society of Arts in 1878.

another may cause derangement whichever way the change is made, from hard to soft or soft to hard. Dr. Parkes thinks that the permanent hardness is of more consequence than the temporary, and that calcic sulphate, magnesian sulphate, and calcic chloride disagree in smaller amounts than carbonate of lime, also that less than ten degrees of permanent hardness may be injurious to some persons.

Hard water is supposed to give to horses a staring and rough coat, and grooms avoid the use of it as much as possible. This would seem to indicate some derangement of the system brought about by the hard water.

It is thought that a hard water keeps better than a soft one, and that it is less liable to absorb organic impurities, properties of less consequence where there is a constant supply than where the supply is intermittent.

(To be continued.)

PASSAGES FROM POPULAR LECTURES.

BY F. T. MOTT, F.R.G.S.

IV. — FERNS.

FROM A LECTURE ON "BRITISH FERNS," 1875.

On the face of this remarkable planet there is no more remarkable plant than that which we English call the *Brake-Fern*, which the Scotch call *Bracken*, the Germans *Saumfarren*, the Italians *Felce femina*, the Japanese *Warabi*, and the Russians *Wodianoi poporotnik*. Common and conspicuous in every quarter of the globe, it has perhaps a familiar name in a greater number of dialects than any other plant. But botanists all the world over know it by the one name of *Pteris aquilina*.

It is interesting for its beauty, clothing our heaths and hills with miniature forests, or standing in motionless armies, curled and crested, "shimmering in the shady wood-light," cool and green while the hot sun blazes in the summer sky. It is interesting also as the type of an order of plants remarkable for their structure, and still more for their history.

If we say that ferns have been growing in this world for ten million years, it is a very rough guess, and must be taken only as representing some vast unknown period to which all history is as one grain in a bushel of mustard seed. But in reading backwards the great inspired Stone-Book, the geological Bible, on nearly every page which speaks of vegetable life there is some record of the ancient family of ferns.

The earliest sedimentary rocks appear to have been deep marine deposits, in which no traces of land plants could be expected; but on reaching the Devonian beds we come upon swamp and shore formations, and here at once the fern-forms show themselves.

As to what the world was like before the Laurentian epoch we have as yet no knowledge. It may be that if ever the beds of existing oceans become inhabited continents, and the present continents the beds of future oceans, other sedimentary deposits will be brought to view still older than the oldest with which we are now acquainted, and will unfold to future explorers the secrets of the dawn of life for which we seek so eagerly and yet so fruitlessly. Or it may be that all those early strata have been melted by internal heat into the granites which seem to underly the fossiliferous strata everywhere, and that their priceless records have thus become unreadable and lost for ever. We only know that the earliest traces we have yet found of land vegetation are the remains of ferns and lycopods, and that there is reason to believe that out of some original variations in the development of some fern-forms, and by a succession of such variations, perhaps at long intervals, during the unknown ages of the past, there grew up gradually the arborescent ferns, the palms, the bamboos, the grasses, the rushes, and finally the beautiful flowering monocotyledons—lilies, irises, amaryllids, and orchids, and that out of some similar variations of the lycopod-form were gradually moulded the tall conifers or fir trees, the broad-leaved oaks, and poplars and sycamores, and at last those flowering dicotyledons, the roses, magnolias, laburnums, lilacs, and all the host which make the glory of our present summers.

But through all these changes the original types have been preserved even to this day. Some individuals may have varied widely, but in every generation some have come true to the leading features of the type. The lycopods of this age are clearly of one order with the lycopods of the coal, and the ferns which grow in our woods are, in essential points of structure, one with the ferns of all ages, though in non-essentials, in points which distinguish species and genera but not orders, the changes are marked and numerous.

At the present time there are known to botanists about 2,600 distinct species of existing ferns. The majority of these inhabit tropical regions and moist situations. Mountainous islands, shaded by woods and surrounded by warm seas and moist atmosphere, are the chosen homes of the fern family. Outside of the tropics the two islands in the northern and southern temperate zones which are richest in fern species for

their respective latitudes are New Zealand in the south and Great Britain in the north. New Zealand has 120 species and Great Britain 40; but the south temperate zone is everywhere richer than the north, in virtue of its more abundant moisture.

The whole of Europe contains only 60 species, and the whole of North America about 150. That Great Britain should have 40 shows therefore that for so small an area it is particularly rich. But then there is no other region in this latitude so warm and moist and hilly, and even within our narrow limits we see the influence of climate, for our damp and mountainous western coasts produce twice as many ferns as the dry flat eastern counties.

As with most cryptogamous plants nearly every species has a wide area of distribution. The brake-fern is absolutely cosmopolitan. The pretty bladder-fern, *Cystopteris fragilis*, is found in all temperate regions north and south, keeping to the high mountain tops within the tropics. Several of our British species besides the brake are found unaltered in New Zealand. Fifteen of our ferns are native also in the United States. One half of our 40 are found in the Himalaya Mountains, and the whole of them are European forms; we have not one which is exclusively British.

Wayside Notes.

THREE NOTED BOTANISTS have passed away during the past two months—Dickson, of Edinburgh; Anton de Bary, of Strasburg; and Asa Gray, of Harvard. We hope next month to give some brief account of their work.

THE VACANCY caused in the chair of "Botany and Medicine," at Edinburgh, by the death of Professor Dickson, has been filled by the election of Isaac Bayley Balfour, the Professor of Botany at Oxford. Professor Balfour's election is one upon the advisability of which botanists were pretty unanimous. He is himself the most distinguished botanist that Edinburgh has produced in recent times, and one of the ablest, if not the ablest, of the exponents of the new school of botany. His father, John Hutton Balfour, known far and wide as "woody fibre," preceded Professor Dickson in the same chair. At his resignation his son was candidate for the post, and it is currently reported that he only lost the succession by a single vote.

WE REGRET to see that Dr. Lapworth has not been elected to the chair of Geology at Oxford, vacated by Professor Prestwich. Professor Green, the successful candidate, is a distinguished member of the Geological Survey, and, with the Survey influence behind him, would probably have carried the election, even had he been a far less capable man than he is. Although the officials of the Survey have not scrupled to annex Dr. Lapworth's Highland discoveries, it is doubtful whether they have forgiven him for making them.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GENERAL MEETING, January 31st, 1888, Mr. J. Levick in the chair; Mr. Herbert Stone and Mr. W. Kinton Parkes were elected members. Mr. J. E. Bagnall, A.L.S., exhibited for Mrs. Hopkins, a series of mounted preparations of birds' plumage to show peculiarities of wings, &c. Mr. W. B. Grove, B.A., exhibited a large specimen of the perfect hymenium of the "Dry-Rot," showing abundance of the tawny spores; and two other fungi, *Gymnosporium bambusæ*, and *Volutella stipitata*, all from Sutton; and a bottle of essence of beef, which had been liquefied by the growth therein of a bacterium.—ANNUAL MEETING, February 7th. Professor Hillhouse, M.A., the retiring president, in the chair. There was a good attendance.—After some formal business, Mr. W. P. Marshall read the report of the council. Deep regret was expressed at the death of Mr. Thomas Bolton, F.R.M.S., the assistant curator and librarian of the society. The life membership, which was intended to be bestowed upon him, owing to his death intervening, had been conferred upon his son, Mr. Thomas E. Bolton.—Mr. C. Pumphrey, the retiring treasurer, made his financial statement, from which it appeared that the total amount of subscriptions received during the year was £190 9s. 6d., leaving a balance due to the treasurer of £1 17s. 6d.—Mr. W. R. Hughes moved a vote of thanks to Professor Hillhouse for his services as president during the past year, which was seconded by Mr. Levick, and carried.—Mr. W. B. Grove, B.A., was elected president for the ensuing year, on the motion of Professor Hillhouse, seconded by Mr. Rabone.—On the motion of Mr. Miller, Messrs. Charles Pumphrey, J. F. Goode, R. W. Chase, Lawson Tait, and A. W. Wills were elected vice-presidents for the year. Mr. Rabone was elected treasurer, and Mr. W. H. Wilkinson and Mr. W. P. Marshall joint secretaries. Mr. Pumphrey, having filled the office of treasurer for the long period of eighteen years, a special vote of thanks was accorded to him. The motion was ordered to be engrossed for presentation to Mr. Pumphrey. Mr. J. E. Bagnall, A.L.S., was elected librarian, and Messrs. Iliffe and Miller were re-elected curators and custodians of the property and instruments of the society. The six elective members of the council were Messrs. Alfred Browett, John Edmonds, James Heaton, H. J. Sayers, G. W. Tait, and Alfred Reading.—BIOLOGICAL SECTION, February 14th. Mr. R. W. Chase in the chair. Mr. R. W. Chase, F.L.S., was re-elected president of the section, and J. E. Bagnall, A.L.S., was elected secretary of the section. A vote of thanks was given to Mr. W. P. Marshall, M.I.C.E., for his services as secretary during the past year. Mr. J. E. Bagnall exhibited, with notes, the following plants: *Ceratophyllum demersum* in fruit from Liverpool, *Alisma Plantago* var. *lanceolata*, *Adoxa Moschatellina*, *Juncus Gerardi*, &c., from Warwickshire localities; for Mr. G. C. Druce, F.L.S., *Saxifraga rivularis*, *Juncus trifidus*, *Goodyera repens*, *Carex lagopina* and other rare plants from East Inverness; for Rev. D. C. O. Adams, fungi *Thelephora laciniata*, and *Polyporus abietinus* from Bournemouth; from the Marquis A. Botini, of Pisa, *Raphidostegium Welwitschii*, from near Pisa. Mr. W. B. Grove, B.A., exhibited, described, and illustrated with microscopical preparations, an interesting parasitical fungus from New Zealand, (with sections of the peritheca), *Cordyceps Robertsii*, which causes the caterpillar on which it grows to assume the appearance of being carved out of wood. Mr. J. Levick called attention to a paper on the flight of birds, on

which subject the president, Mr. R. W. Chase, made some instructive and interesting remarks. Mr. W. P. Marshall, M.I.C.E., read a paper on "The successful Use of Oil to Calm Rough Seas." This paper, which will shortly appear in the "Midland Naturalist," was full and exhaustive, and gave rise to an interesting discussion in which Messrs. Chase, Levick, Cullis, Wilkinson, and Grove took part.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—January 23rd. Mr. A. T. Evans showed pebbles from the Drift, and remarked on the frequency with which fossils occurred in zones; one pebble from the Bunter beds contained a *Lingula leseurii*; Mr. J. Madison, shells from Algiers, mostly Helices; Mr. J. Collins, a fungus, *Peridermium pini*.—January 30th. An exhibition, to which the public were invited, the President, Mr. T. H. Waller, B.A., B.Sc., in the chair. The exhibits were as follows:—Mr. H. Hawkes, a large series of mounted plants showing three forms of disease to which they were liable, viz., parasitic fungi, gall-making insects, and leaf-mining insects; Mr. P. T. Deakin, plants of the district, also a collection of nests and eggs; Mr. C. P. Neville, butterflies and moths; Mr. J. Madison, recent and fossil Planorbis, varieties of *Limnæa peregra*, foreign Helices, and a collection of models of snails and slugs; Mr. F. Shrine, a collection of British reptiles, and a number of cast skins of the ring snake, *Tropidonotus Natrix*; Mr. A. T. Evans, fossiliferous pebbles, from the Drift; Mr. J. W. Moore, macro and micro-lepidoptera; Mr. W. H. Bath, marine algæ; Mr. Delicate, photographs of local scenery; the Society, birds of the district. Not the least interesting part of the exhibition was the collection of microscopes, under which many interesting and unique objects were shown. The meeting was largely attended, and the efforts of the members to excite an interest in the beauties of creation were widely appreciated.—February 6th. A paper was read by Mr. W. Flower, "Notes on the Hive Bee." The writer said bee-keeping was a profitable undertaking if properly studied, and if advantage were taken of the latest improvements in hives. The artificial stamped wax foundation saved much time and waste, and the use of the extractor to remove the honey from the comb allowed it to be used again. The development of the bee from the egg to the imago, male or drone, imperfect female or worker, and perfect female or queen, was fully explained, as well as the different treatment given to the larva of a worker, which would produce a queen if required. The writer considered the various kinds of bees, and remarked on those most suitable for bee-farming. At the close of the paper a modern hive was exhibited, and specimens of comb showing worker, drone, and queen cells, and the members were invited by the writer to inspect his bees at work.—February 13th, Mr. Corbet showed specimens of measles pork. Mr. J. Rodgers, then read a paper on "The Moon," which described it as a world very similar to our own, but without seas or atmosphere, in fact, a worn-out world. By the aid of photography its surface has been as fully explored as some parts of the earth. Observations show that the causes that have brought about the physical features of its surface, are the same that have moulded the surface of the earth; but the scenery of the moon was sharper and showed more asperities from the fact that it has not suffered much from denudation. The plains, mountains, and craters were described, the first as being the beds of dried-up seas, in some cases showing the effects of erosion and disintegration on their margins. The writer concluded that the moon, at one time similar to the earth, was now destitute of life, though formerly capable of supporting it. The paper was illustrated by diagrams of lunar scenery, &c.

THE PRESENT AND FUTURE OF SCIENCE
TEACHING IN ENGLAND;
WITH SPECIAL REFERENCE TO BOTANY.

ADDRESS TO THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL
SOCIETY, AS RETIRING PRESIDENT, BY

W. HILLHOUSE, M.A., F.L.S.

PROFESSOR OF BOTANY AND VEGETABLE PHYSIOLOGY, MASON SCIENCE
COLLEGE, BIRMINGHAM).

When you did me the honour—thirteen months ago—of election to the office of President of this Society, I entered upon its duties with much inward trepidation, knowing that I was following immediately in the wake of a gentleman as much distinguished for urbanity of manner as for energy in work, as much characterised by scientific ability as by willingness to place his knowledge at the disposal of others. Relying, however, upon a courtesy which I had then never known to fail, and upon the warm co-operation of officers who had in many cases grown grey in the active service of the Society, I entered upon my task with the firm determination that during my term of office the interests of the Society should be ever present in my thoughts; and that, if I could not occupy a position upon a level with my predecessors, I would at least allow myself no cause for shame at the extent of the gap which separated me from them.

It is now my duty to follow a custom which time has consecrated, to place a memorial stone upon my year of office by addressing you upon some topic with which I may feel myself to be more or less at home. If I have selected as my subject “The Present and Future of Science Teaching in England, with especial reference to Botany,” it is because I feel, not that I have anything to say which is new or striking, but that, as botanist and as educationalist, my qualifications, whatever they may be, are here likely to meet on common ground.

We have all read the wondrous story of creation’s dawn as pictured in Mosaic writ. The account there given of the evolution of Cosmos from Chaos—the starting up of sequent myriads of organised beings at a Creator’s word—is one which appeals strongly to an imagination overwhelmed with a sense of the vastness and grandeur of the universe, and the nothingness of the foremost of its denizens. But, nevertheless, it leaves a void behind. With all its poetic beauty, there is in it no sign of the eternal fitness which alone can give to it a

sense of probability. It may appeal to the emotional, but it gives no hold to the intellectual part of man to be told of an unending series of different organisms produced by instant but independent creation—organisms of, from the first, such evenly balanced hostility and power, such divers needs and capabilities, that the mere attempt to dwell on the details of their contemporaneous existence seems once more to reduce our mental Cosmos to primeval Chaos. We look in vain for the history of the animal or vegetable denizens of this earth, for their inter-relations, their mutual dependence, and their mutual destruction, for if food was in any way necessary to existence, destruction whether of animal or of vegetable life must have ensued.

But many of us, would that I dared to say all of us, have read another account of Creation's dawn, as given in the "Origin of Species" by, and with all reverence I say it, one who is as pre-eminent in the enunciation of the physical, as was Moses in the enunciation of the moral law. Charles Darwin has painted for us the missing history, the physical history of creation; and, as the narrative of the Hebrew Law-giver derives its first mark of distinctiveness from the picture of the moral conflict between right and wrong involved in the history of the Fall of Man, so that of our nineteenth century Moses derives its reality by depicting to us the incessant struggle between strong and stronger, which is the accompaniment to our physical life. We know that the doctrine of a constant struggle for existence is true, for we know that the sum total of life is limited by the sum total of food, and that while the tendency of all life is to increase and multiply, the sum total of food supply remains more nearly constant. Hence it follows that the sum total of life must remain pretty constant too, other than with such changes as are brought about by the reduction of the food needs of any kind of organism, and that therefore the periodical increment of life must be in some way or other reduced or rendered null.

We know, I say, that this struggle exists. Who has not seen the contest of the weeds for proprietorship of a piece of waste land, and the ultimate victory of the grasses, as endowed with the strongest vitality? But if you want to feel the inevitable nature of the struggle, let us imagine the vast surrounding ocean of this globe containing but one single fish, and that a female herring, with just such a roe as that which, under the name of "hard," you have all, doubtless, often eaten, with its thousands of tiny eggs, each a potential herring. I do not know how many eggs a herring's roe contains, but let us assume, if you will, 2,000. Of these 1,000,

we will say, become female herrings (and in this matter the number of males becomes of secondary importance), and that they spawn once a year: in the

| | |
|-----------------------------------|------------------------|
| 1st year the herring has produced | 1,000 |
| 2nd „ these have produced ... | 1,000,000 |
| 3rd „ „ „ „ ... | 1,000 millions |
| 4th „ „ „ „ ... | million millions |
| 5th „ „ „ „ ... | 1,000 million millions |
| And so on. | |

How many years, think you, assuming (I grant an impossible assumption) unlimited food supply, would it take for the present seas to be packed full of a solid mass of herrings, the displaced water having sought a home elsewhere? Perhaps the cubic capacity of a herring is six cubic inches, if so, 8,000 fill a cubic yard; and though in the second year we shall have but 125 cubic yards of herrings, in the third year we shall have 125,000 cubic yards, in the fourth year 125 millions, and in the fifth 125 thousand millions—that is, upwards of 20 cubic miles; in the sixth year 20,000 cubic miles, and in the ninth year 20 million millions of cubic miles; that is, unless my arithmetic is at fault, in the ninth year our solitary female herring would have produced a mass of herrings equal to 60 or 70 times the entire solid bulk of this globe upon which we live. Nay, more than this, for we have dealt only with the female herrings, and probably an equal bulk of males would be produced; and even then in our calculation we have assumed the death, nay more, the disappearance, of all herrings excepting those of the present year. This is preposterous, you will say, and so it is. But why is it preposterous? Surely not because some proportion of the eggs may be infertile or unfertilised, for at the most that would but delay for a few years the startling consummation already portrayed. No! our premises are impossible; the potentiality of herring eggs is limited by the quantity of herring food, and starvation would await the overwhelming majority of the herrings born, even assuming that starvation does not abort the vast majority of the eggs themselves. In this natural case of supply and demand, this instance of Nature's Malthusianism, this struggle amongst multiplying herrings for limited food, two classes of herrings would survive:—

(1.)—Those of more robust growth, which would by sheer force kill off their weaker brethren, and

(2.)—Those which were capable of sustaining satisfactory life on the smallest amount of material.

Now, although in our actual case we have not to deal with herrings alone, but with fish of other kinds as well, the

principle involved is the same: the survival of those which are marked either by greater strength, stronger vitality, or slighter needs,—the survival of the fittest.

And the law that is true for the herring is true for the man also, and with this addition, that the struggle for food, which once, no doubt, was the sole characteristic of an archaic human race, has been complicated by a struggle for possession and power. We have become very far removed from the period when the sole need of man was food; who can tell how early in the history of the race the struggle for the possession of women was added to it? And to that has been superadded the desire of many other possessions which are limited in quantity, and even the struggle for power as well. Why, this small island of ours, has it not, within that feeble span of time known as “historical period,” been the seat of struggles between Briton and Roman, Gael and Celt, Saxon, Dane, and Norman? No doubt most of these struggles have been struggles not for food ostensibly, but for power; but what is power, but the right to eat, be clothed, and be served by the labour of others instead of by one’s own personal exertions? And the struggle for money to-day is the precise equivalent to this mediæval struggle for power, for to us moderns “money is power,” *i.e.*, is food and clothing, and service, yea, and pride as well.

And now I would wish to draw your attention to one phase of this struggle for food, possessions and power, which is of vital importance to our own subject. The Hebrew Law-giver introduced us from the first to the moral element in man’s nature, the conflict in him of the powers of right and wrong, and the evolution of his constant mentor—conscience. Darwin has given us an insight into the physical side of life, and the incessant struggle amongst all organic creation, including man, for the mere right to live. Perhaps some third Moses, some greater than Herbert Spencer or Kant, may some day unfold to our vision the development of the intellectual faculties, and thus correlate our knowledge of the beginnings and history of mind and matter, soul and conscience.

And surely the time is ripe for this, for if any one thing is more certain than any other, it is that, century after century, year after year, in the history of any advancing section of the human race, empire has been more and more shifting its seat from the muscle and sinew to the nerve and brain. Why, even our very wars, those crudest relics of primeval struggles for food, possession, and power, are fought to-day more with the brain than with the arm. The days of knightly chivalry, when victory lay with the strongest arm, the straightest lance,

and the keenest sword, are gone for ever; one modern invention will work more destruction than a hundred knights, with their men at arms, and that, too, at distances which might o'erleap half-a-dozen mediæval battle fields. Surely the race is not to the swift, nor the battle to the strong, unless it be to the strong in brain, the swift in thought. It would almost appear as if the modern equivalent for *mens sana in corpore sano*, is that the primary object of a sound body is to keep and support a sound mind.

Five hundred years ago the visible contests of our race, as well as the invisible ones, were fought and won by the keen eye, strong arm, skilled hand, and ready foot of our fathers. The result of such a contest depended in the main upon these factors, and, like the wise men that our forefathers in their day and generation were, the education of the male member of society was confined almost entirely to the strengthening of the body, the training of the eye, the hand, and foot. But the inventor of gunpowder undid all that—by slow degrees it's true, but none the less surely. What was the strongest man against a missile which would penetrate a breastplate at hundreds of yards? And so the system of warfare ceased gradually to be one of keeping troops in compact masses, and of trusting to the shock and weight of heavily limbed and armoured men. And with the spread of weapons of precision and range, even the historic "thin red line" is almost a thing of the past, and the actual contact of bodies of armed men is being slowly replaced by the artillery duel at long range, and battles are decided, like games of chess, by superior skill in manœuvring,—true, not bloodlessly; would that they were!

And this is but an emblem of those invisible, but none the less real, contests which form the vast proportion of our struggle for existence. While it is not possible to say that there are no occupations in which bone and muscle are of less value than an active brain, it is none the less true that their number is diminishing, and that there are few indeed in which machinery, the produce of the brain, has not begun to play its part. Thus, then, man contends with man in his own trade, trade conflicts with trade, nation with nation. The reward of victory is money, the right and means to live; the result of defeat is starvation, more or less complete. There is war—civil as well as international—constantly raging, none the less cruel, none the less pitiless, because it is a bloodless war, and is fought with brains instead of arms.

Now, if it was essential in olden time that men's arms and legs, muscles and eyes, should be trained by constant exercise, because upon them fell the brunt of the warfare for the right to live; so now it is equally essential that men's—aye, and

women's—brains should be trained and strengthened, because, in the altered conditions of things, it is upon them that we depend in the main for livelihood. Not that muscle has gone out of use, but simply that it has become subservient to the brain. If it be true that "the pen is mightier than the sword," is it not far more true that the head is mightier than the arm, skill is more powerful than strength?

Education is the training which fits us for the battle of life. The education of the fourteenth century was almost wholly physical, because the struggle for existence was a physical struggle; the education of the nineteenth century must be in the main mental, since the struggle for existence is now mainly solved by its intellectual constituents; not forgetting, however, that the healthiest minds reside in healthy bodies; and, still more essential, that for the production of healthy children, healthy parents are needed.

I need hardly say it is no part of my purpose to go over the whole ground of the educational question. We have so far realised the changing conditions of life, that education, of a kind, is well-nigh universal; but the question I have often put to myself, and the question I would put to you, is—Is the education which we demand and give, that which is best suited for its purpose; are we, in educational matters, on the right track?

The main distinction between ancient and modern warfare, whether in blood or industry, is that the latter is wedded in the closest way with physical science (using this term in its broadest possible sense). All the great victories of peace of this Victorian era have been victories of science; all the great victories of war have been victories gained by science. If, then, the conflict is so essentially a scientific contest, of course the training for the conflict is essentially a scientific training! But is this so? What part I would ask does science play in the education of our people? What proportion of the thirty weekly hours of an average schoolboy's existence is given to physical or biological science, the knowledge of the world which surrounds him, of the laws which govern his existence, and which will govern him in his struggle for the power to live? Is it one-half? No. One-quarter? No. Doubtful, even, if it is one-eighth in the best of cases, and from that it sinks away to nothing! And yet we pride ourselves upon being a practical people, when it is doubtful whether one more unpractical, more improvident, exists upon the face of this earth. Whence is it, then, that this want of appreciation of the teachings of experience comes?

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

.(Continued from page 76.)

Carbonate of lime in water decomposes about $10\frac{1}{2}$ times its weight of common yellow soap, and nearly 9 times its weight of white curd soap in the operation of washing. Other salts of lime or magnesia destroy an amount proportionate to the lime or magnesia they contain. The lime unites with the stearic, or other fatty acid present in the soap, forming the stearate or other salt of lime, and until the lime is so satisfied no lasting lather can be obtained. It follows, therefore, that the water is softened at the expense of the soap, and this is accompanied with the production of insoluble curdy bodies (insoluble soaps).

Considering the large amount of soap used, a soft water is very desirable. Soft water is also much better for making tea, and for most manufacturing processes—brewing being an important exception.

Where a hard water only is available, it would generally be both beneficial and economical to soften it by Clark's process. I believe the Marlstone water might be so treated with advantage to the town. After making large allowances on account of water used for purposes where hardness is of no account, the value of the process may be estimated by the following figures:—

To soften the same amount of water by—

| | £ | s. | d. |
|--|-------|----|------|
| Lime, 1 cwt. | about | 0 | 0 9 |
| Carbonate of Soda, $4\frac{3}{4}$ cwt. | „ | 1 | 13 0 |
| Soap, $20\frac{1}{4}$ cwt. | „ | 28 | 0 0 |

To soften by boiling would be about as expensive as by soap.

At Caterham a very hard water is reduced from 21.2° to 4.4° at a cost of less than £1 per million gallons.

Some waters are greatly benefited in other ways by this artificial softening, as will be explained further on.

Excessive hardness.—A contaminated subsoil or water-bearing bed gives to water percolating through it the power to dissolve large quantities of salts, thus producing excessive hardness. According to recent investigations of Mr. Warrington*, the silica is not increased, and the quantity of carbonates but little. Lime is considerably increased, and

* "A Contribution to the Study of Well Waters," by Robert Warrington, F.R.S. "Journal of the Chemical Society," June, 1887.

magnesia still more. Sulphates are very largely increased. It is the permanent hardness therefore that is chiefly increased. It is scarcely necessary for me to point out that some waters may be highly charged with mineral matter derived from the rocks through which they pass, without any contamination, so the general character of a water-bearing bed must be known before attributing excessive hardness in the water derived from it to contamination.

ORGANIC CONTAMINATION is a much more serious matter than inorganic, and animal matter more dangerous than vegetable, hence any analysis should be chiefly directed to the detection of the former. Animal and vegetable substances contain practically the same things, as a consequence of animals living on vegetables or other animals, but the proportions of these constituents vary. Animal matter contains more nitrogen relatively to the carbon than vegetable; also the excrement of human beings is characterised by the presence of more chlorine, in consequence of the great use of salt as a condiment. A determination of the relative amounts of organic carbon and nitrogen may be very valuable in a recently contaminated water, but since decomposition of the organic matter converts the carbon into carbonic acid gas, and this can no longer be specifically identified from that otherwise introduced, whereas the nitrogen still remains, the method does not seem of general application.

Sewage matter is, unfortunately, very often discharged into, or allowed access to water which must be used by human beings. This matter is not only itself injurious, but it may at any time contain those living germs which are both the product and cause of diseases of an epidemic character. The most objectionable part of sewage in water is that held in mechanical suspension, and not that held in solution, for when the organic matter is fully decomposed the products, though soluble in the water, are not themselves injurious, because incapable of further change, at least of an objectionable kind, in the human body.

Micro-organisms.—With the suspended matters we must class the living organic germs, for it is impossible to conceive that they could suffer solution, and consequent diffusion in the water, and at the same time retain their vitality. A chemical analysis fails to detect the presence of these organisms, and unless they are abundant a microscopic examination may also; hence it is important to know whether they retain their vitality long, also whether they can be separated from the water. With regard to the first point, it is perhaps

not advisable to speak very decisively, but it does seem very unlikely that germs which find such a suitable habitat—for themselves—in the hot fluids of the body would thrive in cold water, and if not they must ultimately die out, and become burnt up. Fortunately with regard to the second point more decided evidence is available, for Dr. Percy E. Frankland has shown that filtration not only separates distinguishable solid particles, but also reduces the number of micro-organisms, the reduction extending to entire elimination, according to the number of organisms present, and the condition or extent of the filter. Spongy iron or coke are the most effective materials at present known, but it is important to know that simple agitation of the water with coke, charcoal, or chalk will effect the precipitation of these organisms, and a like result will be obtained when precipitating the lime in water by Dr. Clark's process of softening. The microbes are not killed by this latter method, and they will re-ascend into the water if it is left long in contact with the sediment.

Records of contamination.—Oxygen dissolved in water is more active chemically than the same gas in the air, and when dead organic matter is discharged into water the constituents are rapidly changed, so that to detect contamination the products of oxidation and decomposition have to be looked for.

The carbon of the organic matter is oxidised to carbonic-acid gas, which remains dissolved in the water, and cannot be identified in an aerated water, since such water would normally contain it.

The hydrogen is oxidised to water, which, of course, cannot be distinguished in the same medium.

The nitrogen is partly converted into *ammonia*, and partly into *nitrous and nitric acids*, which latter substances unite with the bases always present in water which has passed through or over the ground, forming *nitrites and nitrates*; and since rain-water only contains minute traces of the above-named acids, the presence of determinable quantities of these nitrites and nitrates is looked upon as a record of previous contamination, they are considered to be the harmless skeletons of organic bodies. In the chemical changes just referred to we have an imitation of the production of *nitre*. *Nitrates and nitrites.*—It is estimated* that 97 per cent. of the combined nitrogen of London sewage is converted into nitrates during slow percolation through a stratum of gravelly soil only five feet thick. Nitrates and nitrites may them-

* Sixth Report of Rivers Pollution Commission.

selves be decomposed under conditions where there is decomposition going on with a deficiency of oxygen (see ammonia). They are always rapidly destroyed, or taken up by aerial vegetation, and to a less extent by aquatic, so that this kind of evidence may largely disappear from a water.

Ammonia.—The first thing to decompose in sewage is *urea*, and as this yields free ammonia, the presence of much free ammonia in a water is usually a bad sign; it indicates very recent contamination, for this ammonia would soon be converted into nitrites and nitrates. There are, however, cases where free ammonia does not indicate recent contamination. Filtration may indeed increase the amount of free ammonia at the expense of albuminoid ammonia.* Again, in underground waters the nitrates and nitrites may be themselves decomposed in order to yield oxygen for the oxidation of some organic matter still remaining, and then the nitrogen may be partly evolved as *ammonia* and partly as *free nitrogen*, and the latter would be lost sight of.

Protoxide of iron may sometimes reduce nitrates and nitrites, taking their oxygen to form a peroxide, and setting free ammonia. Sulphates may even be reduced by the protoxide of iron in a similar manner, and so yield *sulphuretted hydrogen*.

Albuminoid Ammonia.—Many waters contain nitrogenous organic matter in a form in which the nitrogen is only slowly evolved as ammonia by the action of strong oxidising agents, the ammonia so evolved is spoken of as albuminoid ammonia; much of this and little free ammonia would usually indicate vegetable contamination.

Chlorine is often a valuable criterion of contamination in a water, because the chlorides introduced by sewage are not filtered out, or decomposed, though they may be taken up to some extent by plants in the soil, or in a stream. If the normal quantity of chlorine in a water from any particular bed is known, then the chlorine estimation is useful as indicating, if in excess, animal contamination.

It will have been noticed that all the chemical changes just described, as occurring in water, tend to purify it, and that the ultimate products of these changes are bodies of a simple nature, bodies not liable to further change, and, therefore, not injurious in a water. I would only now point out that these changes are chiefly effected by filtration and aeration, the two operations which are so particularly provided for in the plan suggested for filling up the Marlstone.

(To be continued.)

* See "Water Analysis," by J. Alfred Wanklyn, M. R. C. S., pages 98 to 104.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 62.)

Since the publication of the last number of this history I have examined the English Flora of Sir J. E. Smith for notices of Worcestershire plants. The first edition of the Flora, in 4 vols., 8vo, was published at the following dates: Vols. I. and II., 1824; Vol. III., 1825; Vol. IV., 1828. A second edition of the whole work appeared in 1828. It has yielded the following records:—

VOLS. I. AND II., 1824.

Campanula hederacea. On Hartlebury Common. Rev. T. Butt. *This is the only original record of C. hederacea on Hartlebury Common, and is one of doubtful correctness, as the plant has not been seen in that locality by any other botanist. It is on the authority of the same observer that Gnaphalium margaritaceum is recorded from Wyre Forest, in the Botanists' Guide, 1805.*

Pyrola media. Wyre Forest, near Bewdley. Dr. Pratington. *(Pratinton.)*

* **Cuscuta europæa.** At Shipston-on-Stour. Rev. Dr. Jones.

* **Daphne Mezereum.** At Eastham and Stanford. Rev. E. Whitehead *(Rector of Eastham).* *This is the same record as that in Purton, Vol. III., p. 33, 1821.*

VOL. III., 1825.

* **Vicia bithynica.** Between Chockenhall and Sandling, in Worcestershire. Rev. Dr. Abbot. *Cherkenhill and Sandlin, in the parish of Leigh.*

* **Gnaphalium margaritaceum.** By a rivulet in the heart of Wyre Forest. Rev. T. Butt. *This is the same record as that in the Botanists' Guide, 1805.*

† * **Inula Helenium.** I noticed it in 1795, between Worcester and Ludlow. *But query in what county?*

VOL. IV., 1828.

Epipactis purpurata. See ante, p. 59.

* **E. ensifolia.** On the top of Abberley Hill and in Wyre Forest. Mr. Moseley.

From a notice of the life of the late Mr. Edwin Lees, in Berrow's "Worcester Journal" of the 29th October, 1887, we learn that in the year 1828 Mr. Lees, who was then a printer and stationer in Worcester, published, under the name of Ambrose Florence, a stranger's guide to the city and cathedral. I am indebted to my friend, Mr. R. F. Towndrow, of Malvern Link, for a description of this book,

which is in the reference department of the Public Library in Worcester. It is entitled "*The Stranger's Guide to the City and Cathedral of Worcester, including a concise description of every remarkable and interesting object contained therein, with an account of the Battle of Worcester, and a sketch of the principal objects of Natural History observable in the vicinity*, by Ambrose Florence, Worcester, printed by Edwin Lees, 87, High Street, 1828." At pages 152 to 156 is "A Catalogue of Plants growing wild in the vicinity of Worcester," which Mr. Towndrow has been so obliging as to copy for me. As this is the first catalogue of plants from the neighbourhood of the city, and Mr. Lees's first contribution to the botany of the county, I have thought it worth while to reprint it, simply altering the sequence of the species and omitting the English names.

Edwin Lees in Ambrose Florence's "Stranger's Guide," 1828:—

* *Ranunculus Lingua*. Ockerley Wood, near Holt. *The locality referred to is Ockeridge Wood.*

* *Aquilegia vulgaris*. Leigh Sinton.

Papaver somniferum. Shore of the Severn.

* *Cardamine amara*. Side of Laughern Brook.

* *Dianthus Armeria*. Clerkenleap Cliff.

* *D. prolifer*. Field below Malvern Church.

A doubtful record.

* *Saponaria officinalis*. In a hedge near Mudwall Mill.

* *Montia fontana*. Plashy rills on the Worcestershire Beacon, Malvern.

* *Geranium lucidum*. Top of Merryman's Hill.

* *Vicia sylvatica*. Clifton-on-Teme.

* *Lathyrus Nissolia*. Footway to Norton.

* *L. sylvestris*. Perry Wood, &c.

Prunus Cerasus. Wild Cherry Tree, near Gregory's Mill, &c.

Must be Prunus Avium, L.

* *P. insititia*. Bullace. Hedge at Battenhall.

* *Spiræa Filipendula*. West side of Perry Wood.

* *Sanguisorba officinalis*. Side of Nunnery Wood.

* *Rubus Idæus*. In a copse at Bevereye.

* *Rosa spinosissima*. Abundant in the lane leading to the Virgin's Tavern.

R. gracilis (a form of *Rosa involuta*). Thicket near the rill that runs from Battenhall Farm; a most beautiful species.

* *R. villosa*. Battenhall and Helbury Hill.

R. tomentosa. At Bransford, &c.

- R. Sherardi.* Thicket beyond Battenhall Lane (*a form of the preceding*).
- * *R. rubiginosa.* Foot of Cruckbarrow Hill. (*Cruckbarrow Hill.*)
- R. micrantha.* At Bransford.
- R. Borreri.* Perry Wood, &c. *A form of R. canina.*
- Pyrus torminalis.* Clerkenleap, &c.
- * *P. domestica.* Wire Forest.
- * *Oenothera biennis.* Side of the Teme below Powick Bridge.
- Circæa lutetiana.* South part of Perry Wood.
- * *Sedum Telephium.* Wet meadow, near Bubble Bridge.
- * *Cotyledon Umbilicus.* Roseberry Rock, Knightwick.
- * *Sium latifolium.* Side of Henwick Old Weir Pond.
- * *S. angustifolium.* In a damp copse at Bevereye.
- * *Oenanthe Phellandrium.* In a pool at Kempsey Grove.
- * *Meum Fœniculum* (*Fœniculum vulgare*). Spetchley.
- * *Chærophyllyum sativum.* In profusion on the sides of the Tewkesbury Road, just beyond the turnpike, where Dr. Stokes noticed it in 1775.
- * *Myrrhis odorata.* Side of the Royal Mount, facing the London Road.
- * *Viburnum Lantana.* In the hedge of a plantation near Berwick's Bridge.
- Lonicera Caprifolium.* Copse beyond the Ketch.
- † *Galium pusillum.* East side of Red Hill. *This must be a reference to the record by Stokes of Galium scabrum as growing at this spot. G. scabrum is a var. of G. Mollugo; G. pusillum, Smith, is a limestone plant of the northern counties, not known in Worcestershire.*
- * *Asperula odorata.* Woods about Leigh Sinton, &c.
- Valeriana rubra.* On the old wall of the western entrance to the Cloisters.
- * *V. dioica.* Meadow above Bubble Bridge on the Laughern Brook.
- * *V. officinalis.* Nunnery Wood.
- * *Dipsacus pilosus.* Banks of the Laughern, and in a bushy place near the Severn at Grimley.
- * *Scabiosa succisa.* Near Diglis Basin, but most numerous by the side of the Droitwich Canal.
- † *Campanula glomerata.* Knightsford Bridge. *Must be an error. It is not acknowledged in the Botany of Worcester as a native of the Malvern district.*
- * *C. Rapunculus.* Hindlip.
- * *C. patula.* Borders of Perry and Nunnery Woods.
- * *C. hederacea.* On Hartlebury Common. *A repetition of the record by the Rev. T. Butt in Smith's English Flora.*
- * *Pyrola rotundifolia.* Abberley Hill. *This must be a repetition of Dr. Sheward's record in Nash's Supplement, 1799.*

- * *Vinca major*. Side of the road opposite Rainbow Hill, &c.
- * *V. minor*. Covering the side of the copse on the red marl rock at Clerkenleap, and another at the base of Cruckbarrow Hill in a beautiful manner.
- Datura Stramonium*. Near Bevereye.
- * *Verbascum virgatum*. South side of the lane near Gregory's Mill.
- * *V. Blattaria*. Side of the road between Powick and Newland.
- * *Antirrhinum (Linaria) Cymbalaria*. City walls.
- * *A. majus*. Walls about the Commandery.
- † * *Veronica triphyllos*. Northern extremity of the Link Common, near Malvern. *An error*.
- * *V. officinalis*. Top of Helbury and Ronk's Wood Hills.
- * *V. montana*. Wood at the west end of Powick Ham, and wood at the south side of Shrawley Church, near the pool.
- * *V. scutellata*. Ditch on the Crowle Road.
- V. Anagallis*. Brook above Gregory's Mill; and with pink blossoms, side of Berwick's Pool.
- * *Lathræa squamaria*. Foot of the North Hill, Malvern.
- Mentha viridis*. Side of a rill near Newland.
- * *Salvia Verbenaca*. Side of the London Road at Red Hill.
- Lithospermum officinale*. Near Battenhall.
- * *Anchusa sempervirens*. Under an elm tree, in a field by the river side beyond the old Water Works.
- Borago officinalis*. Lane at Bromwich Farm.
- * *Cynoglossum sylvaticum*. Near the third milestone to Pershore.
- Hottonia palustris*. In a ditch near Crowle.
- Primula elatior*. Oxlip Primrose. Coppice near Bransford Chapel, where there are several curious varieties of *Primula*. *This is not the true Oxlip, but P. vulgaris, var. caulescens.*
- * *P. veris*, var. Black or Deep-red Cowslip. In a pasture on Bromwich Farm.
- * *Lysimachia vulgaris*. Powick Weir.
- * *Polygonum Bistorta*. Near Roseberry Rock, Knightwick.
- Parietaria officinalis*. City walls, &c.
- * *Lemna gibba*. Lower Bishop's Pool, Northwick.
- * *Butomus umbellatus*. In Laughern Brook.
- * *Ophrys apifera*. Cracombe Hill.
- * *Neottia spiralis (Spiranthes autumnalis)*. On Cruckbarrow Hill.
- * *Serapias (Cephalanthera) ensifolia*. Abberley.
- Iris fœtidissima*. Base of Cruckbarrow Hill.
- * *Narcissus biflorus*. In the field at the top of Clerkenleap Marl Cliff, near the Ketch, two miles and a half south of Worcester.
- * *N. Pseudo-narcissus*. In the thicket below, in profusion.
- * *Galanthus nivalis*. On the east side of King Stephen's Embankment at Henwick.

- * *Paris quadrifolia*. In a copse overshadowing a boggy glen, between Worcester and Cruckbarrow Hill.
- * *Convallaria majalis*. Shrawley Wood.
- Tulipa sylvestris*. On Clerkenleap Marl Cliff.
- Ornithogalum nutans*. Field at Clerkenleap.
- O. pyrenaicum*. At Cotheridge.
- * *Allium vineale*. On Pitchcroft.
- A. oleraceum*. In the same habitat as *Narcissus Pseudo-narcissus*.
- A. ursinum*. Near Cruckbarrow Hill.
- * *Colchicum autumnale*. Abundant in the meadows by the Severn.
- * *Eleocharis acicularis*. Severn Stoke.
- * *Scirpus cæspitosus*. Bromsgrove Lickey.
- Milium effusum*. Wood near Powick Ham, &c.
- Aira flexuosa*. Helbury Wood Hill, and wood on the Broadheath Road.
- Holcus mollis*. Meadows on the western side of Severn.
- * *Festuca Calamaria*. Shrawley Wood.
- * *F. pinnata* (*Brachypodium pinnatum*). Near Pershore.
- * *Bromus diandrus*. Severn Stoke.

This is Bromus madritensis, L., and must be a repetition of Dr. Stokes's record. See With., 2nd edit., p. 107.

B. velutinus. Helbury Hill.

This is a form of Bromus secalinus, subsequently noted by Scott.

Elymus europæus. Wood Lyme Grass. Malvern Hills, near the Wych.

This is the grass now known as Hordeum sylvaticum, Hudson.

* *Nardus stricta*. Malvern Chace.

The Catalogue is disappointing in one or two particulars. No distinction is made between plants observed by Mr. Lees himself and those recorded on the authority of other observers. It does not contain a single Composite, and several other important natural orders are very insufficiently represented. The total number of plants recorded is 106, of which 27 are new records. *Rosa tomentosa*, *R. micrantha*, *R. Borreri*, *Pyrus torminalis*, *Circæa lutetiana*, *Datura Stramonium*, *Mentha viridis*, *Lithospermum officinale*, *Tulipa sylvestris* are contained in the List of Plants on the Malvern Hills in Loudon's Magazine of Natural History, and are entitled to precedence.

Parietaria officinalis, *Milium effusum*, *Aira flexuosa*, *Holcus mollis*, *Bromus secalinus* are entitled to precedence over the records of the same plants in Scott.

(To be continued.)

PASSAGES FROM POPULAR LECTURES.

BY F. T. MOTT, F.R.G.S.

V.—THE AIM OF LIFE.

FROM A LECTURE DELIVERED IN JUNE, 1879.

To what end is that vast machinery of Life, which covers everywhere, as with a delicate network, the outer surface of this flying globe ? It is the puzzle of the ages, the riddle of the Sphynx, the insoluble problem. We may find out the curious processes by which a tree sucks food from the air, the rain, and the soil. We may count the bones in a human body, or calculate the leverage of muscles, or trace the fine threads by which sensation is communicated from the skin to the brain. We may roughly imitate the organic machinery, as in a watch or a phonograph, or a locomotive engine, but we cannot catch the Vital Energy itself. We cannot put *that* into our artificial apparatus. We may burn fuel under the boiler, but we cannot make our engine *feed*. We cannot make a dead stick grow, nor put a soul into a waxwork figure. Hitherto the element of life has proved too subtle for us. It may be, as some suppose, that it is no more than gravitation, or magnetism, or chemical affinity acting under more complex conditions ; but to explain it thus, is only to say that the earth stands upon an elephant, and the elephant upon a tortoise, and the tortoise upon—what ? If life is gravitation, what then is gravitation ? Why do all the particles of matter attract one another ? Why, when a ball is set in motion, will it fly on for ever until something stops it ? What is this Force, this Energy, which is at the bottom of all the actions and processes of matter whether dead or alive ? In the presence of this question our philosophers stand silent. In all our researches we are met at last by this omnipresent and unexplainable Energy, and we can go no further. As far as we can see its conduct is always uniform, and may be foreseen and predicted with a certainty exactly in proportion to our knowledge of the conditions. We have learnt to trust absolutely to the uniformity of its conduct under uniform conditions, and we call its modes of action “ laws of nature.” But we can only watch its workings with wonder and admiration. We know of its existence only because in the human personality or soul it takes on the form of self-consciousness, and so looks back upon itself, and *feels* its own

existence, not with any material organ, but with that "inward eye which is the bliss of solitude," because there is nothing so delightful and inspiring as the vision of "things unseen."

I ask you to consider whereto is tending the work of this all-pervading Energy on the surface of this globe ? Its latest and most wonderful outcome is animal life ; and without doubt the completest form of animal life, of which we have any knowledge, is human life, also it is the last and latest of all vital forms.

What then is the meaning and the purpose of humanity ? Why do we live and die ? Why do we grow in knowledge and in power ? Why do we love, and hate, and struggle after a number of objects which attract us ? Why are we happy one hour and miserable the next ? What is it that we chiefly want ? What is our highest good, the best thing attainable, the summit and climax, the end and aim of life ?

In spite of all our researches and speculations, the origin of the human race is utterly unknown to us. We are still disputing whether it was slowly developed by special conditions of climate and food, out of some lower form of animal life, or whether it flashed upon the world like the coming of a meteor ; whether its first condition was that of the dark-skinned savage out of which the nobler forms have blossomed ; whether the Negro and the wild Indian are degenerate offspring of a race originally fair and wise ; or whether all known forms have existed side by side since first the world was habitable.

We may believe in one theory or the other, or we may trust to none of them, but the actual and present fact is plain, that between man and all other animal life there is now a deep wide chasm. Whatever may be our ancient blood-relationship with inferior races, no human being is ever now mistaken for a monkey, nor has any form of monkey been discovered which could be dignified with the name of man. There are many attributes by which man is distinguished, none more notable than this, that he is the one *discontented* being. However much he may enjoy the present, there is always something in the past which he remembers regretfully, something in the future which he anticipates with hope.

" We look before and after
We pine for what is not."

This is, no doubt, the necessary condition of a being who is still in process of development, not yet perfected, and who possesses the faculty of self-consciousness. If the rose-bud were conscious of its daily growth, it also would "look before and after," would speculate on its unseen and unknown

destiny, would feel that its path was upward towards something not yet reached, and would be stirred, as man is stirred, with golden hopes and irrepressible aspirations.

What then is it that man hopes for ? Passing by all lesser hopes and wishes, what is that which, if he could reach it, would completely satisfy him ?

Here part company two schools of thought. A thinker of one type will tell you that what man longs for is happiness ; give him perfect happiness and he is for ever content. The other school repudiates this doctrine ; maintains that there is a hope beyond the hope of happiness ; that this highest and subtlest aspiration exists in all branches of the human family, but is strongest and clearest in the noblest souls ; that it is not a desire to *have* anything, or to *feel* anything, but simply to *be* whatever the imagination pictures as the completest development of humanity. I take my stand with the latter school, and I think it of vital consequence to the progress of civilisation that the pursuit of happiness as the end and aim of life should be denounced and made as unpopular in theory as I believe it is actually untrue in fact.

NOTES ON THE WARWICKSHIRE STOUR VALLEY AND ITS FLORA.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 71.)

In many parts of the district the fences are of stone often loosely put together without cement. These loosely constructed walls are rarely the habitats of flowering plants, unless it be here and there the tiny whitlow grass, but the mosses, content with a thinner soil, not unfrequently spread their velvety mantle over these otherwise bare places, and we see beautiful masses of *Hypnum cupressiforme*, *H. rutabulum*, *Homalothecium sericeum*, and rarely the creeping stems of *Leucodon sciuroides*, and the coping-stones are frequently covered by great masses of *Barbula intermedia* and *ruralis*, or the *majus* form of *Bryum capillare*, or pretty little cushions of *Grimmia apocarpa* and *G. pulvinata*, serried ranks of *Orthotrichum saxatile*, silver-tipped tufts of *O. diaphanum*, and the ubiquitous *Barbula muralis*. But in the villages these walls are usually cemented and capped with mud, and then there is often an abundant crop of *Pottia lanceolata*, *P. intermedia*, *P. cavifolia*, *Tortula aloides* and *ambigua*, and rarely *T. rigida*. Of flowering plants everywhere we are reminded of the advent of Spring by the

cheerful little *Erophila vulgaris*, and the pretty *Saxifraga tridactylites*, whilst about Brailes, Tysoe, and Whatcote, I have found *Poa compressa*, *Festuca rigida*, and *F. myurus*. The walls about Honington Hall are gay with the purple-flowered *Linaria Cymbalaria*, but this cannot claim to be more than an alien weed.

Besides these stone fences, however, the good old Warwickshire hedgerows are a conspicuous feature in many parts of the valley, and these have not only gratified my eyes with their beautiful hawthorn, apple, and rose blossoms, but have filled my vasculum to repletion with noticeable brambles, rare roses, and other plants of equal interest. *Clematis vitalba* is rare, I have only seen it at Oxhill; *Euonymus europæus* and *Berberis vulgaris* are recorded from Honington; *Rhamnus catharticus* and *Ligustrum vulgare* are frequent, the latter evidently wild. *Viburnum Lantana* and *Cratægus oxyacanthoides* occur at Great Wolford, Long Compton, and Barton-on-the-Heath, *Prunus Cerasus*, a single tree, near Brailes, *P. avium*, Wolford Heath, *P. insititia* and *P. fruticans* at Illmington, Wimpstone, and Atherstone-on-Stour, and *Pyrus Aria*, a single tree, on Wolford Heath. The protean bramble is abundant in many parts of this district, the ubiquitous *R. discolor* being prevalent; besides this I have found *R. diversifolius* rather frequent. *R. rhamnifolius* at Great Wolford, Burmington, Halford, Tysoe, and Long Compton. *R. pubescens*, Atherstone-on-Stour, Tysoe, Compton Warren, and Brailes. *R. macrophyllus* (type), Hill Clump (*F. Townsend*), and Great and Little Wolford. *R. glabratus*, Compton Warren. *R. echinatus*, Compton Wynyates! (*F. Townsend*), Great Wolford, Long Compton, and Barton-on-Heath. *R. pallidus*, Little Wolford and Brome Hill. *R. cæsius*, Atherstone-on-Stour, Little Wolford, Illmington, and Halford. *Rosa tomentosa* is rare, I have only seen it at Great Wolford. *R. inodora*, a very rare Warwickshire rose, occurs near Oxhill; but the dog-rose with its many forms is beautifully abundant. The robust *R. surculosa* grows about Oxhill, Easington, Illmington, and Wimpstone. *R. frondosa*, Lower Tysoe and Oxhill. *R. tomentella* (type) only near Whatcote. *R. andegavensis*, Illmington and Wimpstone. *R. glauca*, Illmington. *R. subcristata*, Lower Tysoe and Oxhill. *R. Watsoni*, at Oxhill, on the way for Whatcote.

Whilst there is abundant evidence that that portion of the Stour Valley south of Brailes Hill has formerly been heath land, there are now no heaths such as we get in North Warwickshire, that is, wild wastes covered with abundant heather, ling, gorse, broom, and wood sage. The land has

been reclaimed and is either arable, meadow, or woodland, and the isolated spots still to be found yielding true ericetal plants are merely the survivals of a wilder past. Near Great Wolford is one of these places. It consists of a couple of pastures, having a large pool at one end, and surrounded on all sides by woods and coppices, and the following plants, the result of a two hours' examination, will give some idea of the former prevailing flora. Here, for the first time in this district, I saw *Nardus stricta* in abundance; with this was also growing *Erica Calluna*, *Erica cinerea*, *Carex præcox*, *C. pilulifera*, *C. pallescens*, *C. binervis*, *C. fulva*, *C. panicea*, *C. flava* var. *minor*, *C. pulicaris* in wonderful abundance, *C. rostrata*, *Myosotis versicolor*, *M. collina*, *M. umbrosa*, *Festuca ovina*, and var. *capillata*, *Sieglingia decumbens*, *Montia fontana*, *Taraxacum palustre*, *Juncus supinus*, the small heath form of *Potamogeton polygonifolius*, *Veronica scutellata*, *Zannichellia palustris*, *Scirpus fluitans*, *Peplis Portula*, *Callitriche obtusangula*, *Myriophyllum alterniflorum*, *Galium saxatile*, *Galium Witheringii*, *G. uliginosum*, *Sium erectum*, *Apium inundatum*, *Triglochin palustre*, and *Aira flexuosa*. I was unable to find another spot in this locality so prolific in true heath plants, but saw isolated examples at intervals, among these *Callitriche hamulata*, *Catabrosa aquatica*, and *Stellaria uliginosa*.

I also found in the same locality some noticeable mosses, such as *Aulacomnium palustre*, *Pogonatum aloides*, *Hypnum splendens*, *H. brevirostre*, *H. striatum*, *H. myosuroides*, *H. piliferum*, *H. glareosum*, *Polytrichum formosum*, *Dicranella varia*, *Dicranum palustre*, *D. scoparium*, and, what was more pleasing, *D. undulatum* (Ehrht.), which was new to Britain. Several Hepatics were noticed: *Cephalozia bicuspidata*, *Pellia epiphylla*, *Scapania irrigua*, and *S. nemorosa*.

Another spot near Illmington, which has more the aspect of a moorish pasture, plentifully covered with *Ulex europæus*, and with several small marshy pools, yielded many interesting plants, such as *Ænanthe Lachenalii*, *Æ. fistulosa*, *Myosotis palustris*, *Ranunculus Drouetii*, *R. tricophyllus*, *Glyceria pedicellata*, *Molinia cærulea*, *Gentiana Amarella*, *Samolus Valerandi*, *Thymus Chamædrys*, *Carduus acaulis*, *Chara fætida*, and the rare *Tolypella glomerata*. This locality was also rich in mosses, such as *Fontinalis antipyretica*, *Hypnum giganteum*, *H. fluitans*, *H. intermedium*, *H. Kneiffii*, *H. cordifolium*, *H. lycopodioides*, and *H. elodes*, the two last being new to the county. Also, among the Hepatics, *Pellia calycina*, *Aneura pinnatifida*, *Calypogeia Trichomanes*, and *Radula complanata*. On the drier parts of this common there was an abundance of *Hypnum molluscum* and *Camptothecium lutescens*. Near Tysoe and

Brailes are also some gorsey declivities which still show evidences of a former wilder condition. These are deep descents falling from an elevation of about 700 feet to about 350 feet, and yield some of the plants already noticed, and, in addition, abundance of *Apargia hirta*, and *Bidens tripartita*.

Coming, lastly, to the waters of the district, I am not able to give so full an account as I should have wished. The long dry summer of 1887 was unfavourable for the investigation of these places; deep pits and pools were in many cases quite dried up, and the beds of several of the streams were without trace of water. The River Stour itself is very unlike the river I noticed in a former paper, the Anker, for in the Stour we see no great tufts of *Butomus* or *Scirpus lacustris*, or forests of *Lythrum Salicaria*, or *Glyceria aquatica*, or floating masses of *Sagittaria* or *Potamogeton natans*, such as constantly occur in the Anker; but usually a narrow rapid stream with comparatively bare banks and but few aquatic weeds. Still, now and again we meet with aquatics in abundance, as at Halford Bridge, where *Potamogeton flabellatus* is wonderfully abundant and *P. lucens* may also be seen. *P. perfoliatus* I saw in the river at Burmington, *Sagittaria* and *Butomus* are both recorded from Honington, *Lythrum Salicaria* and *Myriophyllum spicatum* are recorded from Halford, and *Hesperis matronalis* Mr. Townsend records from near Honington. Among the plants recorded by Mr. Newbould from Honington are the rare *Apium graveolens*, *Epilobium roseum*, and *Samolus Valerandi*, and on the river bank near Burmington I noticed *Petasites vulgaris* abundant.

The total recorded flora of the Stour Valley is now 683 flowering plants, ferns and fern allies, and 122 mosses. I think it very probable that several more flowering plants will be added to the list by a more thorough examination of some of the woods and other places in those portions of the district remote from railway stations, and I am persuaded that the moss flora will be materially augmented, as the time given to the district has been too limited to allow this portion of the flora to be exhaustively worked.

Classes of Citizenship.—These have been ably defined by Mr. Hewett C. Watson in the “Compendium of the Cybele Britannica” thus: “*Native*. Apparently an aboriginal British species, there being little or no reason for supposing it to have been first introduced into this island by human agency;” as examples: *Corylus*, *Bellis*. “*Denizens*. Apparently wild, but liable to suspicion of having been introduced by human agency, whether by design or by accident;” as examples: *Chelidonium*, *Vinca*. “*Colonist*. A weed of cultivated land,

or by roadsides, and seldom found except where cultivation exists ;” as *Ranunculus arvensis*, *Alopecurus agrestis*. “ *Alien* species are those plants certainly or very probably of foreign origin ;” as *Acer Pseudo-platanus*, *Sedum reflexum*. “ *Casual* species are chance stragglers from cultivation, such as are found on waste heaps, railway embankments, and sometimes in cultivated fields ;” as *Trifolium hybridum*, *Medicago sativa*.

The 683 plants found in this valley are made up as follows :—

| | | | | | |
|----------------------------------|-----|-----|-----|-----|-----|
| Natives | ... | ... | ... | ... | 502 |
| Denizens | ... | ... | ... | ... | 12 |
| Colonists | ... | ... | ... | ... | 26 |
| Aliens | ... | ... | ... | ... | 13 |
| Casuals | ... | ... | ... | ... | 5 |
| Varieties | ... | ... | ... | ... | 80 |
| Species not classified by Watson | ... | ... | ... | ... | 45 |
| | | | | | 683 |

The twelve *Denizens* are *Chelidonium majus*, *Hesperis matronalis*, *Geranium pyrenaicum*, *Melilotus officinalis*, *Sedum reflexum*, *Ægopodium Podagraria*, *Sambucus Ebulus*, *Matricaria Parthenium*, *Vinca minor*, *Chenopodium Bonus-Henricus*, *Ulmus suberosa*, *U. montana*.

Aliens.—*Cheiranthus Cheiri*, *Corydalis lutea*, *Cochlearia Armoracia*, *Dianthus Armeria*, *Acer Pseudo-platanus*, *Medicago sativa*, *Ribes nigrum*, *Sedum album*, *Linaria Cymbalaria*, *Populus alba*, *P. nigra*, *Taxus baccata*, *Elodea Canadensis*.

Casuals.—*Brassica Rutabaga*, *Stellaria nemorum*, *Melilotus arvensis*, *Trifolium hybridum*, *Vicia sativa*.

The species not classified by Watson are the segregate species of Batrachian *Ranunculi*, and of the genera *Rubus*, *Rosa*, *Salix*, &c., placed under a separate number in the 8th edition of “The London Catalogue of British Plants.”

Types of Distribution.—In making out the types of distribution of the plants found in the Stour Valley I have again had recourse to Mr. Watson’s valuable work, in which he gives six leading types of distribution, which may be briefly shown thus :—

- 1.—British Type.—Species widely spread through South, Middle, and North Britain.
- 2.—English Type.—Species chiefly seen in S. or S.-M. Britain.
- 3.—Scottish Type.—Species chiefly seen in N. or N.-M. Britain.

Intermediate Type.—Species chiefly seen in Mid-Britain.

4.—Highland Type.—Species chiefly seen about mountains.

5.—Germanic Type.—Species chiefly seen in East Britain.

6.—Atlantic Type.—Species chiefly seen in West Britain.

For the sake of comparison I give the following table, which will show the distribution of native plants throughout Great Britain and the relative distribution in the Valley of the Stour :—

| TYPES. | BRITAIN. | STOUR. |
|--------------|-------------------|-----------------|
| British | 532 | 386 |
| English | 409 | 144 |
| Germanic | 127 | 5 |
| Atlantic | 70 | 0 |
| Scottish | 81 | 4 |
| Highland | 120 | 0 |
| Intermediate | 37 | 2 |
| Local | 49 | 0 |
| | <hr/> 1,425 <hr/> | <hr/> 541 <hr/> |

Having, in a somewhat incomplete way, given an account of the Flora of the Stour Valley so far as my present knowledge serves, I may now, in conclusion, mention those plants not at present recorded, and which, taking into consideration the soils and other belongings, may yet be found in this valley. As, for instance : *Ranunculus circinatus*, *Nasturtium palustre*, *N. amphibium*, *Cardamine amara*, *Genista tinctoria*, *Trifolium arvense*, *Vicia tetrasperma*, *Valeriana dioica*, *Achillea Ptarmica*, *Tanacetum vulgare*, *Campanula Trachelium*, *Veronica montana*, *Rumex Hydrolapathum*, *Euphorbia amygdaloides*, *Allium ursinum*, *Luzula maxima*, *Carex acuta*, *Milium effusum*, *Melica uniflora*, and *Poa nemoralis*. All these are widely spread in the county, and most of them are plants which one would naturally expect to see in many parts of this valley. All have been carefully looked for during the past season, so that even if not absent they must be rare in the whole district.

Other absentees are local in the county as a whole, and will probably be very local in this district. Among these are such plants as *Helianthemum Chamæcistus*, *Lepigonum rubrum*, *Hypericum humifusum*, *Geranium lucidum*, *Erodium cicutarium*, *Geum rivale*, *Potentilla procumbens*, *Rosa micrantha*, *Chrysosplenium oppositifolium*, *C. alternifolium*, *Echium vulgare*, *Pedicularis palustris*, *Daphne Laureola*, *Parietaria officinalis*, *Potamogeton zosterifolius*, *Carex paniculata*, *C. echinata*, and *Ophioglossum vulgatum*.

THE RECENT LANDSLIP AT LAKE ZUG.*

BY WM. PUMPHREY.

It is needless to dilate on the exceeding beauty of the Lake of Zug. Whether we stroll along its banks, glide over its blue-green waters, or look down on it from the heights of the Rigi, the idea that it leaves on the mind is that nothing like treachery or lurking danger can possibly be hidden under so peaceful an exterior; and yet, the recurrence of disasters similar to that of last July seems to indicate that all is not as secure as it seems.

The eastern side of the Lake of Zug is formed by a range of hills, hardly mountains, but which, at its southern extremity, rises into the Rossberg, so well-known as the source of the great berg-fall or land-slip of 1812. The town of Zug stands at the north-eastern corner of the lake, where the hills, still keeping a northern direction, leave the shore of the lake; thus the greater part of the town is backed up by hills, but a suburb turns westward and follows the shore of the lake. All this northern shore, and the country for some miles to the north of it, is very level, and is traversed by several small streams that find their way into the lake; while at the north-western angle the waters discharge themselves by a river, which, a few miles further down, joins the waters of the Reuss that issue from the lake of Lucerne. The high road, from Zug to Lucerne, runs along this northern shore of the lake, and a street of houses—chiefly of wood—extends for about half a mile along the road, at a distance of some thirty or forty yards from the margin of the lake. The railway station is very near this street, and has near it a pier at which the steam-boats that ply on the lake land and embark such passengers as have arrived by railway, &c., or are about to depart by it. Within sight of this pier is another pier close to the town, and at this all the steam-boats call before they arrive at the railway pier. In passing from the town pier to the railway pier, the steam-boat crosses a shallow bay, which is fringed by the suburban street of which I have spoken.

On July 5th, about noon, as the steam-boat was crossing this shallow bay, the passengers could scarcely credit the evidence of their senses when they saw some of the houses, which formed a portion of the street, sink down and disappear. Later in the afternoon other buildings gave way, and before

*Read at a Meeting of the Birmingham Natural History and Microscopical Society, Geological Section, November 15th, 1887.

the day was over about thirty houses, among which was a new hotel, had fallen. In the first fall a considerable number of persons, perhaps between twenty and thirty, were drowned, or crushed among the ruins; later in the day no loss of life occurred. There have been in Switzerland many land-slips and many subsidences, but this differs from almost all others. Here there was no sliding down, no forward-thrust from any moving mass, but, almost without a warning, a portion of a street of houses standing on a dead flat sank down, and in a few minutes, where substantial buildings had stood, there was nothing but mud and water and floating wreck.

Our party was staying for a few days at Lucerne, and when, on the morning of the 6th, the news reached us, it seemed almost incredible. We could not but think that the disaster was exaggerated, and, as Lucerne is only about eighteen miles from Zug, we determined to run over and see for ourselves. We went, armed with cameras, for we hoped to obtain trustworthy mementos of the calamity. We found the little town in a state of great excitement, its usually quiet streets thronged with Switzers from all parts of the Confederacy, but of the ruins we could see but very little. The state of things in the neighbourhood of the fallen houses was so perilous that no persons, except those engaged in removing furniture, &c., were allowed to approach, and the soldiers of the Canton guarded every point of access. We were therefore obliged to return to Lucerne with scant information, but well satisfied with having made the attempt. The Rev. E. Hill, of St. John's College, Cambridge, who visited the spot about a fortnight after the disaster, when the excitement had passed away, and when no further danger or damage was apprehended, and when consequently it was comparatively easy to investigate the cause of the catastrophe, read an interesting paper on the subject at the meeting of the British Association in Manchester. He stated that the soil, for the first ten or twelve feet, consisted of silted matter, the detritus brought down by the streams, and which detritus forms the level flat spoken of above as existing at the northern end of the lake. Below this tolerably firm stratum there exists, to an unknown depth, a soft, spongy, semi-fluid formation, which, were it not for the waters of the lake, would ooze out and occupy a still lower level. Under ordinary conditions the pressure of the water maintains the ooze in its position, but any circumstances that would disturb this pressure, or increase the weight of the super-incumbent mass, would have a tendency to destroy the equilibrium, and cause a movement towards the deeper parts of the lake's bed.

Now, there have been, within historic times, two previous subsidences similar in kind to that which has just occurred—the one about 400 years ago, and the second 100 years since. On both of these occasions the subsidence appears to have been initiated by engineering operations, by which the level of the waters of the lake was suddenly lowered, and, as a consequence, the support they gave to the ooze removed. On the present occasion, the theory is that the accumulation of buildings had exerted such an increasing pressure on the upper stratum, that the weight was sustained with difficulty; that a condition of unstable equilibrium resulted, and that this unstable equilibrium was disturbed by some pile-driving operations which were proceeding in connection with the formation of a new pier. It is supposed that the concussions arising from this cause disturbed the pressure and the firmness of the supporting medium, and that the ooze, having lost some of its support, slid forward, and let down the strata above, bringing with it the houses, &c., that were erected on its surface.

THE DISCOMYCETES OF THE BIRMINGHAM DISTRICT.

BY W. B. GROVE, B.A.

The publication of Mr. Phillips' Manual of the British Discomycetes affords a good opportunity for the revision of the species of that group which have been noticed in the three counties of this district. The following list is founded chiefly on the specimens preserved in my own herbarium, but to make it more complete, all the other species of which I can find trustworthy records have been added.

The total number contained in the "Manual" is 615, of which a few over one hundred, or a sixth part of the number found in the whole British Islands, have as yet been discovered here. It will be noticed that the Discomycetēs, in Mr. Phillips' acceptation of the term, embrace some species which have been usually regarded in this country as more closely allied to the Hysteriaceæ.

I have marked with an (=) those of which I myself possess specimens, all of which have been carefully revised and compared with the descriptions in the "Manual." Many of these have been confirmed or named by Mr. Phillips himself, to whose constant and willing help I take this opportunity of acknowledging my indebtedness. The records

collected from other quarters have been indicated by a cross (×); a few have been communicated by Mr. Bagnall, and the rest are from Withering and Purton, and from Lees' "Botany of Worcestershire," or from the "Manual." Six recorded by Purton from the neighbourhood of Alcester, but without definite locality, are indicated by "Midlands."

| | Wk. | Ws. | St. | | Wk. | Ws. | St. |
|-------------------------------|----------|-----|-----|---------------------------------------|----------|-----|-----|
| <i>Morchella esculenta</i> | = | | | <i>Helotium pallescens</i> | = | = | |
| <i>rotunda</i> | | = | | <i>phyllophilum</i> | = | | |
| <i>semilibera</i> | × | × | | <i>claro-flavum</i> | = | | |
| <i>Helvella crispa</i> | = | × | | <i>pruinatum</i> | = | | |
| <i>lacunosa</i> | × | | | <i>herbarum</i> | = | | |
| <i>elastica</i> | × | × | | <i>Mollisia cinerea</i> | = | = | = |
| <i>Leotia lubrica</i> | = | × | | <i>Riccia</i> | = | | |
| <i>acicularis</i> | = | | | <i>urticina</i> <i>Peck.</i> | = | | |
| <i>Mitrula paludosa</i> | × | | | <i>atrata</i> <i>var. plicata</i> | = | | |
| <i>Spathularia flavida</i> | | × | | <i>trifolii</i> | = | | |
| <i>Geoglossum hirsutum</i> | × | | | <i>Lachnea coccinea</i> | = | = | |
| <i>glabrum</i> | = | × | | <i>macropus</i> | × | | |
| <i>Rhizina undulata</i> | = | | | <i>hemispherica</i> | Midlands | | |
| <i>Peziza cupularis</i> | × | | | <i>Summeriana</i> | × | | |
| <i>onotica</i> | | × | | <i>umbrorum</i> | = | = | |
| <i>leporina</i> | × | | | <i>umbrata</i> | = | | |
| <i>aurantia</i> | = | = | = | <i>scutellata</i> | = | | |
| <i>badia</i> | | × | | <i>stercorea</i> | = | = | |
| <i>cochleata</i> | = | = | | <i>theleboloides</i> | = | | |
| <i>micropus</i> | × | | | <i>Dalmeniensis</i> | = | | |
| <i>venosa</i> | × | = | | <i>Lachmella cerina</i> | = | | |
| <i>vesiculosa</i> | = | = | | <i>palearum</i> | = | = | |
| <i>cerea</i> | Midlands | | | <i>calycina</i> | = | = | = |
| <i>Crouani</i> | × | | = | <i>nivea</i> | = | = | |
| <i>asperior</i> | = | | | <i>virginea</i> | = | | = |
| <i>polytrichi</i> | | = | | <i>apala</i> | = | | |
| <i>rutilans</i> | × | | | <i>sulphurea</i> | = | | |
| <i>humosa</i> | = | | | <i>dematiicola</i> | = | | |
| <i>granulata</i> | = | = | | <i>hyalina</i> | = | = | = |
| <i>omphalodes</i> | = | | | <i>Tapesia cæsia</i> | = | | |
| <i>Hymenoscypha</i> | | | | <i>eribasis</i> | = | | |
| <i>tuberosa</i> | = | | | <i>fusca</i> | = | = | |
| <i>Curreiana</i> | = | | | <i>Boudiera areolata</i> | | = | |
| <i>firma</i> | = | | | <i>Ascobolus glaber</i> | = | = | |
| <i>tuba</i> | × | | | <i>denudatus</i> | | | × |
| <i>coronata</i> | = | | | <i>furfuraceus</i> | = | | |
| <i>virgultorum</i> | = | | = | <i>immersus</i> | = | = | |
| <i>fructigena</i> | × | | | <i>Ascophanus</i> | | | |
| <i>calyculus</i> | × | | | <i>minutissimus</i> | = | | = |
| <i>scutula</i> | = | | | <i>carneus</i> | | = | |
| <i>hyperici</i> <i>Karst.</i> | = | | | <i>pilosus</i> | = | = | |
| <i>cyathoidea</i> | = | = | = | <i>ciliatus</i> | = | | |
| <i>solani</i> | = | | = | <i>Bulgaria inquinans</i> | = | | |
| <i>Chlorosplenium</i> | | | | <i>Vibrissea leptospora</i> | = | | |
| <i>æruginosum</i> | = | = | | <i>Ombrophila sarcoides</i> | = | | |
| <i>Helotium ferrugineum</i> | = | | | <i>Pocillum Boltonii</i> , <i>Ph.</i> | = | | |
| <i>citrinum</i> | = | | | <i>Calloria stereicola</i> | = | | |
| <i>uliginosum</i> | = | | | <i>leucostigma</i> | = | | |

| | Wk. | Ws. | St. | | Wk. | Ws. | St. |
|----------------------|-----|-----|----------|-----------------------|-----|-----|----------|
| Calloria fusarioides | = | | | Phacidium radians | | × | |
| vinosa | = | | | ilicis | = | = | |
| rubella | = | | | rubi | × | | |
| Encœlia fascicularis | | | Midlands | dentatum | | | Midlands |
| Dermatea nectrioides | | = | | Stegia ilicis | = | = | = |
| carnea, <i>var.</i> | | = | | | | | |
| amœna | = | | | Less certain records. | | | |
| cerasi | × | | | Peziza tectoria | | × | |
| Cenangium prunastri | | × | | Helotium lenticulare | | | Midlands |
| ferruginosum | | = | | Lachnella bicolor | | | Midlands |
| Propolis pyri | = | | | | | | |
| versicolor, alba | = | = | | | | | |

(To be continued.)

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—**GEOLOGICAL SECTION**, February 21st. Mr. T. H. Waller, B.A., B.Sc., in the chair. Twenty-three members present. A very interesting series of photographic views, taken by Mr. C. J. Watson, in Wales, was exhibited by Mr. Chas. Pumphrey with the oxy-hydrogen lantern. As each view was projected on the screen, Mr. C. J. Watson pointed out its special features. Among the views particular mention should be made of Conway, the Fairy Glen, Aberglaslyn Pass, Pass of Llanberis, and Mawddach Valley. The attention of the section was continually drawn to the distinctive marks of glaciation so abundantly shown in the photographs. Mr. C. J. Watson showed some fine specimens of minerals from Wales, including galena, blende, quartz crystals, calcspar, &c. Mr. Chas. Pumphrey has kindly consented to exhibit (by the oxy-hydrogen lantern) photographs of parts of Switzerland and Germany, on the 20th of March.—**Adjourned Annual Meeting**, March 6th. The President, Mr. W. B. Grove, B.A., in the chair, there was a large and influential attendance of members. Professor Hillhouse, M.A., F.L.S. (the retiring President), delivered an interesting address on the "Present and Future of Science Teaching in England, with special reference to Botany." A discussion followed, in which the President, Messrs. W. R. Hughes, F.L.S., R. W. Chase, J. Levick, J. Cullis, A. Browett, and T. H. Waller took part, and a hearty vote of thanks was accorded to Professor Hillhouse for his able and far-reaching address.—**BIOLOGICAL SECTION**, March 13th. Mr. R. W. Chase in the chair. Mr. J. E. Bagnall exhibited *Equisetum sylvaticum* var. *capillare*, from Shirley, Derbyshire; *Lastrea dilatata* var. *dumetorum*, from Kerry; *L. dilatata* var. *collina*, from Pembridge; *L. spinulosum* var. *exaltum*, from Bishopwood, and several other rare ferns. Also, from Mr. F. T. Mott, a beautiful series of the various forms of the common shepherd's purse, *Capsella Bursa-Pastoris*, from Leicester; for Mr. G. C. Druce, F.L.S., *Eriophorum Capitatum* and *E. alpinum*, from St. Moritz, Helvetia; and from Rev. D. C. O. Adams, *Campylopus brevifolius*, a rare moss, from near Bournemouth. Mr. J. Levick called attention to the high price recently given for a great auk's egg, which elicited from the President, Mr. R. W. Chase, a great amount of interesting matter on the subject, which he promised to give in greater detail at some future meeting. Mr. W. B. Grove, B.A., then gave his paper "On New and Noteworthy Fungi, Part IV." This paper abounded in truly interesting and instructive matter, and was ably illustrated by specimens and beautifully executed drawings. A discussion followed, in which the President, and Messrs. J. E. Bagnall, J. Levick, and W. P. Marshall took part.

VOLITION.

BY CONSTANCE C. W. NADEN.

(Continued from page 57.)

Now, let us turn to voluntary actions; to those actions which are immediately preceded or accompanied by a conscious mental effort in their own direction. These evidently must depend on the cerebral centres, since no other centre conducts its operations consciously. Whether any other centre conducts its operations with effort is another question, which I shall touch presently.

Volitional actions are of two kinds — *initiatory* and *inhibitory*. The *initiatory* may give the signal for the beginning of a series of automatic actions. For instance, the first step in starting for a walk is volitional, but the effort is slight and does not require to be maintained. Or the action initiated may have been performed rarely or never before, and then the *initiatory* effort has to come in at every stage. The action may be physical or purely mental; it may be learning to dance or learning a foreign language, or applying muscular or intellectual energy to any kind of labour or study. In the same way, *inhibitory* volitions may concern thoughts or things; we may try to refrain from some reflection, or from some deed.

Every voluntary action, whether *initiatory* or *inhibitory*, is preceded by or bound up with an act of attention, which is itself volitional, and both initiates by turning the mind in its own direction, and inhibits by suppressing tendencies in other directions. Wundt, in his "Physiological Psychology," compares *apperception*, the product of attention, to the *point* of distinct vision, while simple perception, which follows upon mere inattentive sensation, corresponds to the entire *field* of vision. He says "Apperception is the primitive voluntary action, the performance of which is always presupposed in the external voluntary actions. The condition necessary for the execution of a voluntary movement is the apperception of the representation of that movement." He points out that our own feelings inform us of the state of nervous tension—accompanying that state of consciousness called attention, and constituting its physical side. It should be added, however, that even attention may be unaccompanied by any sense of effort, and thus, according to our definition of volition, may be called involuntary. This may be due to automatism, as when the subject is familiar; or due to impulse, as when the

subject is strongly fascinating ; or to a mixture of the two. The novel-reader is conscious of no effort of attention when absorbed in some delightful work of fiction ; but set him down to a scientific treatise, and his sense of effort may come little short of headache.

By the aid of an ingenious apparatus called Hipp's chronoscope, Hersch, and subsequently Wundt, have been able to measure the time required for a voluntary response to any given stimulus ; this time of response averages from $\frac{1}{8}$ th to $\frac{1}{5}$ th of a second, and decreases with the increased energy of the stimulus ; and, by subtracting the time taken up in nervous transmission to and from the brain, Wundt obtains the duration of the three processes of perception, apperception, and volition. These processes, which he calls "psycho-physical," usually require a much longer time than the purely physiological processes of transmission. But, if, by means of a preparatory signal, the observer is led to *expect* the stimulus at a given instant, the psycho-physical stage may be greatly shortened, and may even be reduced to zero, so that the response takes no longer than a simple reflex action. Or the response may even be simultaneous with the stimulus. Wundt explains these phenomena in the following manner:—When the preparatory nervous tension has attained its highest point, the prepared movement can no longer be restrained, and the nerve-energy overflows into action, so that we respond to an irritation from within, instead of to a stimulus from without. Thus the apperception and the responsive volition no longer constitute two stages, but are fused into one act of will.

I now return to the consideration of the two classes of volitions ; initiatory and inhibitory.

The distinguishing quality of initiatory volitions is that they are non-automatic. They cannot be predicted, and even when considered as responses to simple stimuli, they are liable to indefinite variation, dependent on the constantly varying condition of the cells of the cerebral cortex. Therefore, the machinery of volition has, as it were, to be readjusted every time it comes into action, and its responses cannot be made without a certain effort. Yet volitions, like impulses, avail themselves of automatic mechanism, and in return strengthen that mechanism. For when the action is once started volitionally, it very frequently proceeds automatically, as in the already-cited case of setting out to walk ; indeed, all our voluntary actions are to some extent intermingled with automatic elements, otherwise life would be intolerably difficult, and progress impossible. We can speak, because

we have learned to speak; read, because we have learned to read; dress ourselves, because we have learned to dress ourselves; that is, because in each case a mechanism has been gradually constructed, which needs only a touch to set it going. This touch—the volition—is really of the nature of an *impulse*, and can be distinguished from impulse only by its inferior strength, or by the superiority of the obstacles that stand in its path. It is an impulse either intrinsically feeble or strongly opposed. Often two volitions conflict, causing a painful mental struggle; often volition and automatism conflict, the volition trying to turn the thoughts from a habitual channel, and not succeeding unless it be so strong and energetic as to merit the name of impulse, or unless the counter-channel be well-worn. Will has little or no effect on the *primary* automatic actions, such as coughing, or irritation of the larynx, heart-beating, the contraction of the iris; because their channels are better worn than the channels of any secondary automatic actions can possibly be.

But how can a volition be truly *inhibitory*? If a volition be a comparatively faint impulse, how can it ever overcome a powerful impulse? It must be remembered here that everything hinges on that word “comparatively,” and that if a strong initiatory volition is opposed to an impulse of moderate strength, the sense of effort may be transferred to the impulsive side, which then, by our definition, becomes volitional. But an inhibitory volition seems usually to be a mixture of impulse and automatism, in which automatism preponderates. An effort of will is generally powerless to restrain the expression of emotion, unless there is an ingrained *habit* of self-restraint; a habit which may be inherited, or may have been born of *impulse* of some rival emotion, as fear or love. This is acknowledged in the common phrase—“the triumph of principle over passion.”

The impulse to be inhibited may be powerful, and yet may be neutralised by a comparatively faint counter-impulse setting at work the moral machinery.

Among a number of similar cases related by Dr. Maudsley in the “Pathology of Mind” is the following:—“On several occasions I have been consulted by a married lady, the mother of several children, who is afflicted with recurring impulses to kill her youngest children, of whom she is most fond; she cannot bear sometimes to be in the room with them when there are knives on the table and no one else is present; and she is driven to retire to her bedroom, where she weeps in an agony of despair, because of what she calls her wicked thoughts, and prays frantically to be delivered

from them." Here the emotions, and the whole force of moral automatism, were enlisted against the insane impulse, which thus seemed not a part of the character—not, so to speak, a part of the self—but a wicked suggestion from without.

The subject, perhaps, will be clearer if we study the nature of initiation and inhibition in the lower centres. Even the spinal cord can originate; as we learn from that well-known brainless frog, who when a spot of acid is dropped on the inner surface of his thigh, will try to rub it off with the foot of the same leg, and if this foot be cut off, will use the other. Mr. Lewes tells us that it is not every frog who hits on this expedient, for sometimes a frog will bend its body towards the injured leg, "so as to permit the spot to be rubbed against the flank." A brainless animal can even *learn* to execute combined movements; that is, actions which, if conscious, would be called volitional now become automatic in the ordinary sense of that term. "There is," says Freuberg, "a decided improvement acquired in the reactions of the motor-centres after divisions of the spinal cord, not indeed in vigour, but in delicacy. Removed from the regulating influence of the brain, the legs acquire through practice a power of self-regulation." *

These are examples of that wonderful power of self-adaptation to the environment, which is not confined to nervous tissue, but is manifested even by the lowest organisms, at least as regards the absorption and assimilation of food, and is shown by higher animals not only in their voluntary actions, but in their organic functions, and in the phenomena of acclimatisation, possibly also in other phenomena, not completely explicable by the Natural Selection hypothesis. Indeed, this power of organised tissues may perhaps be regarded rather as a condition than as a product of Natural Selection. Could we discover all its conditions, even self-adaptation might reveal itself as automatic, although depending on adjustments so delicate as to transcend all ordinary conceptions of automatism. But to return to the pithed frog.

The self-adaptation of the spinal cord is not volitional, because not conscious; but, since it involves a *variation* of the habitual course of action, it corresponds with volition on the objective or physiological side. The only difference is, that the sense of conscious effort, or the subjective side of volition, is absent. Initiatory volitions, then, have their counterpart in the functions of the spinal cord.

As regards inhibitory volitions, the correspondence is even more marked. Mr. Lewes states as follows what he calls the "Laws of Discharge and Arrest":—"The simultaneous influence of several stimuli, each of which excites the same centre, is cumulative; stimuli then assist each other, and their resultant is their *arithmetical* sum. Simultaneous stimuli, each of which excites a different centre, *interfere* with each other's energy, and their resultant is their *algebraical* sum."* Thus, a reflex action may be inhibited by the stimulation of a sensory nerve, even when the cerebrum is removed. In a frog from which the hemispheres have been taken, stimulation of the optic lobes and optic thalami delays the reflex action; and a like effect is produced by stimulation of any afferent nerve. "If the fore-leg of a headless frog be irritated, the hind leg will also be moved by the stimulation, or *vice versâ*. Here, then, has been a propagation of the excitation in either direction. But if while the legs are thus irritated, and the centres are ready to discharge, another and more powerful irritation reach the centre—say by pinching the skin of the back—there will be no discharge along the legs."† In these and similar instances it is evident that inhibition may take place either because the opposing stimulus is the stronger, or because the path for the action which it initiates is better worn, though doubtless the latter case occurs more frequently in the higher and less completely mechanised centres than in the lower ones.

I have now completed my attempt to answer the question with which this paper began—"What is a voluntary action?"—and have only to sum up results. I have tried to show that actions may be classified as "automatic" and "impulsive"; the former being characterised by definiteness, the latter by variability, and hence apparent spontaneity. There is no separate physiological class of "voluntary" action, although in the regions of psychology, such a class may still be admitted. Such actions always seem in a peculiar sense our own, and, as we say, the product of our own free will, because the sense of effort which distinguishes them brings more prominently into consciousness the *mental* factor, as opposed to the mere stimulus, which, in effortless automatic and impulsive actions, seems to carry all before it.

As Dr. Johnson said, "We feel we are free, and there's an end on't"—or, if we are not willing that there should be such a summary end, we must content ourselves with the knowledge that our actions are free in the only intelligible

* "Physical Basis of Mind," Problem II., ch. viii.

† Ibid.

meaning of the word; that is, they flow from the laws of our own nature. The impulses of insanity and intoxication seem to over-ride these laws, and in a certain sense do over-ride them, by deranging the functions of the brain; thus the drunkard or the madman is no longer, during his paroxysms, a free agent. His actions do not flow from the laws of his nature, so much as from the laws of his disease.

In speaking of the "Will," we have to guard against the natural assumption that the same word always means the same thing. What do we mean, for instance, when we speak of a man of strong Will? Sometimes we mean that he is a man of strong Impulses, who dominates and tyrannises over others by the force of his passions. But his Volitions—the conscious efforts of his mind—may be few. Or again, we may mean that he is a man of strong Principles; that his trains of thought and moral feeling are definitely organised, so that his moral nature acts automatically. But in this case, if there are few Impulses needing to be inhibited, there will be few Volitions.

A man of Will, then, is not necessarily a man of Volition.

THE PRESENT AND FUTURE OF SCIENCE TEACHING IN ENGLAND; WITH SPECIAL REFERENCE TO BOTANY.

ADDRESS TO THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL
SOCIETY, AS RETIRING PRESIDENT, BY

W. HILLHOUSE, M.A., F.L.S.

PROFESSOR OF BOTANY AND VEGETABLE PHYSIOLOGY, MASON SCIENCE
COLLEGE, BIRMINGHAM).

(Continued from page 86.)

The difficulties in the way of the systematic teaching of science in schools belong to one of several heads. Perhaps the most important of these is the *historical difficulty*. The educational system of an old country is not constructed; it has grown. In our relations with institutions in the general body politic we constantly come across this method of reasoning:—"Were we to formulate a brand new constitution such and such a thing would find no place in it. It is there now merely because it has been there in the past. It has no other *raison d'être*. Does not logic demand, therefore, its removal." But I do not think we can fully appreciate the historical difficulty merely by thus looking at matters. That which has grown up in a nation's life is not like a rock

lying in the middle of a road, demanding only to be removed. Every change, of whatsoever kind, creates a certain amount of social disturbance, which in itself may be harmful, and the true thinker has not to balance only the profit of the new against the profit of the old, but has to reckon in his balance-sheet in some way or other with the disturbance which has been created, and the cost of making the change. Just as when the manufacturer may for years and years go on manufacturing his particular type of goods by means of machinery which is manifestly old-fashioned and comparatively ineffective, when other machinery may be in existence by which the same work is much better done, the unthinking are apt to jeer. But the manufacturer cannot simply compare his profits under the old with those under the new system; a vital factor in his calculation must be the cost of reconstruction. Unless the new process will recompense for this it is truer economy to go on in the old way.

We cannot fully realise the condition of educational matters in England without duly considering the fact that until only, so to speak, the other day nearly all the education that was worthy of the name lay in the hands of the old educational foundations of this country. The methods of teaching, the subjects taught, were white with the snow of centuries. In many cases even the founder's will strictly defined the nature of the bulk of the curriculum, and the schoolmaster was fettered more or less closely by chains forged at a time when education had barely escaped from the monopoly of the priesthood and the bar. With generation after generation, generation after generation, trained upon the same narrow lines, we can feel no sense of surprise that the schoolmaster's curriculum became surrounded with a halo of mystic reverence, and that he who ventured to touch it even with his thoughts should be deemed iconoclastic. It is true that educational reformers came and went; the name of Arnold alone might stand in evidence of this. But the educational reformer of the past dealt rather with the methods than with the subjects of education. Can we be surprised then that even to-day, with the modern spirit working strongly within us for years, the fine old crusted "liberal education" of our grandsires should only have been shaken, should hardly have been reconstructed. It is as hard for the leopard to change his spots as for the older type of educationalist to change his conviction that the Alpha and Omega of a liberal education are summed up in the two words "Latin" and "Greek." A new generation has sprung up, but of them it cannot be said that they "knew not Joseph." They are the field in which is being, and has to be, fought out the

battle of the old principles and the new. We have grown up imbued with the new gospel of education; it is ours to carry that gospel one step further on, and hand it to our successors still more fully impregnated with the spirit of the new life.

The second great difficulty in the way of the thorough teaching of science in schools is *Ignorance*. I do not by this mean ignorance in the crudest sense of the word. I mean ignorance of the objects and realities of scientific knowledge, ignorance of what its acquisition may lead to. In many minds such ignorance is closely allied to dread. The teaching of Greek and Latin lend stability to the national constitution; the teaching of physical and biological science is revolutionary and may unsettle the foundations of our state and our religion. I cannot but acknowledge that there is some small apology for this feeling. Exponents of science have not been at all times sufficiently careful to distinguish between the proven and the problematical; and some brilliant hypothesis which scientists themselves take for what it is, and no more than it is, may serve to shock and frighten off a whole army of semi-converts, while it heightens the distrust of the totally unconverted. Now we have no more right to expect that the man of science should clip the wings of his Pegasus, and linger solely on this solid earth, than we have to ask that a Milton should restrict his daring irreverence, and deal solely with the clay of our common humanity. But in our teaching we are, I think, justified in asking more. To carry into practical effect the famous dictum of Wordsworth, the king of the school of poets of Cosmos—

“To the solid ground
Of Nature trusts the mind that builds for aye;”—

we are justified in asking that in our teaching we shall distinguish between the known and the unknown; we are not justified in teaching to children as known that which is only hypothecated; we are not justified in teaching a doctrine before the nature of the evidence on which that doctrine is based can be understood, appreciated, and weighed. You will see, then, in effect we are here carrying out the principle of one of the greatest of educational reformers, Pestalozzi, that children should not so much be taught as shown how to find out things for themselves. A child will not find out a doctrine, but a child can find out portions of the evidence on which a doctrine is based.

Having now somewhat cleared the way, we are in a position to go further into this subject of science teaching in schools. If there is anything upon which as a nation we

pride ourselves, it is on being a "practical people." The "practical man" is a great factor in our public and also in our educational life. Nor can we affect surprise at this. Your practical man has usually very clear ideas; they may be limited, but they are not indistinct. He sees his way marked out before him, and follows it unerringly. The chances are he has attained wealth, and nowhere is wealth more deified than here. The man who has attained his own ends so successfully must surely be the man to strike out the best path for others. All this is very plausible, and hence the practical man largely has his own way.*

Now, I do not hesitate, as an educationalist, to say that, in matters of education, the so-called practical man is a grave danger. It is true that he, in common with all teachers, looks upon education as a means of fitting the youngster for the battle of life. He says the youngster will have such and such things to do hereafter; fit him for them. But if he had his way entirely, his "fitted" youngster would be but a machine. "Oh," he says, "what's the good of teaching him so and so? Teach him something that will be useful," for your practical man is nothing if he is not utilitarian. To the practical man we owe all that is unhealthy in the current demand for technical education. To him the boy is simply a machine to do work of some kind or other, and every extra wheel or band beyond those that are necessary detract from the value of the machine.

But is this an ideal of education? God forbid that this earth should be peopled by piece workers without a thought or hope beyond their tiny sphere of labour. How much better is his than the ignorance of the countryman, whose soul's loftiest flights never carry him out of reach of the aroma of his pig-stye? No, I cannot help thinking that in our craving for the useful, we risk losing sight of the educational. Without forgetting other principles, ought we to throw away what surely is the most fundamental of all, that the value of a subject for educational purposes should be gauged by its educational value? It sounds almost like a

* That I may not be mistaken as to the sort of man I refer to, let me quote from the "Arabian Nights," Lane's Edition, 1877, Vol. I., p. 141. The Second Royal Mendicant, describes how, having been robbed of all he possessed, he found himself destitute in the city of his father's greatest enemy. A kindly tailor takes pity on him, feeds and clothes him, and then asks him: "Dost thou not know any trade by which to make gain?" I answered, "I am acquainted with the law, a student of sciences, a writer, and an arithmetician." "Thy occupation," he said, "is profitless in our country; *there is no one in our city acquainted with science or writing, but only with getting money.*"

truism to say this; yet let us ask ourselves what it means. Does it not mean this, that a child is born into the world with a certain range of faculties and powers—physical, intellectual, and moral. If these faculties are neglected they will lie in abeyance, be gradually deadened, ultimately lost. The true duty of education is to take each and all of these faculties, neglecting no one of them, and to cultivate them to the greatest attainable height of perfection. Those subjects are of the greatest educational importance which, effort for effort, produce the greatest educational results. “Give me a fact, sir,” says the practical man. “Give me a thought,” says the true educationalist. As I have said elsewhere*—“To use the power of thought and reasoning, this is a prime factor in true education; and I would rather have a man who thinks wrongly than one who does not think at all. There is hope for the one, none for the other. Once get principles and reasons well grounded and the facts marshal themselves. Facts without reasons are like a fleet of vessels without crews, capable of no concerted and intelligent action, but nevertheless readily capable of mutual destruction.”

I think the child himself teaches us the true method of education. How delighted at the discovery of something new, how receptive of impressions, how quick in attempting generalisations,—probably inaccurate, but none the less educational for that. It is only when you come to crush the child's life into things that it does not and cannot understand or appreciate, that its brightness becomes dulled, its receptiveness deadened. The child has taught you the grand educational principle that observation is the first phase of intellectual education.

And here it appears to me that the special value of science in education comes in, viz., that all sciences are based on observation, and, if there be any truth in our preliminaries, that branch of science which is most provocative of observation should hold pre-eminence in early educational training. I cannot help, therefore, venturing to think that the handiwork of the “practical man” is to be seen in the comparative monopoly of school scientific education by Chemistry and Physics. I do not wish to say one word against the importance of either of these subjects; but what I mean is this. The practical man sees that Chemistry, for example, has brought about great economic results, by which much wealth has accrued to the nation, and, therefore, by one of those intellectual efforts peculiar to him, imagines that it must be

* Pharmaceutical Conference, 1886; see “Pharmaceutical Journal,” Sept. 18, p. 237 *et seq.*

the best subject to teach to children ! But if we are to adopt our standard of educational merit, Chemistry must take a place, as an educational subject, certainly not at the top of the experimental sciences.

One last thought, and I have done with this part of my subject. What do we do for the training of the eyes of our children ? Next to nothing. It is true, and from the very nature of the case, that the eyes are in constant use, but this is not what I mean. What the eyes require is systematic training, so as to produce the ability to use them with minute accuracy and with rapidity. Give a piece of very accurate work to the ordinary artizan, and you will find by bitter experience that, what with "rule of thumb" and "near enough," those two great curses of our artizan population, your chances of an accurate result are small indeed. We shall never recover our vanishing position in the industrial world until accurate correlation of eye and hand are an essential part of our educational system, and for this purpose drawing, and one of the biological sciences—sciences purely of observation and experiment—and that, preferably, Botany, as the one most suited for school teaching, should, if properly taught, be found of inestimable value. I ought, however, to restrict here my application of the term Botany to that which to botanists is known as "Morphological" botany; for physiological botany, the knowledge of the life-history of plants, dependent as it so largely is upon a prior physical and chemical training, could find a place only in the latest stages of the schoolboy's career, if at all. I have no sympathy whatever with the mere teaching of scientific facts; with the observation of those facts I have abundant sympathy.

As scientific method is, in all cases, practically like, it may facilitate my task if I refer for one moment to this. Four stages are to be recognised in this method: (1) *Observation*, whether of natural phenomena, or of results brought about by experiment; (2) *Classification*, or the arrangement, by comparative methods, of the results of observation; (3) *Deduction*, that is inferences drawn from observed phenomena and hence application to unknown things; and (4) *Verification*, that is, the process whereby the accuracy of our conclusions is tested. Now as far as school purposes are concerned, I make bold to believe that no branch of science whatever approaches in value in all of these respects to the study with the fuller teaching of which my life is occupied, or rather to that portion of it which we call systematic and morphological botany; and, as the four steps in scientific method noted above represent with tolerable accuracy also four stages in the evolution of the mental power

of man, observation is naturally that which should first be taught. And in this highly artificial and crowded town life of ours, so fraught with evil—social, moral, physical, and intellectual,—it is of more than ordinary importance that the child shall have its life so attuned as to vibrate with ease to the touch of natural beauty, that it shall have every inducement placed in its way to forsake the crowded streets and alleys, the drawing-room and the study as well as the gin palace and the beershop, and seek by contact with Nature in the fields and lanes, the hills and the valleys, fresh inspiration wherewith to charm the drudgery of its daily toil for bread.

(To be continued.)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 95.)

“The Midland Medical and Surgical Reporter and Topographical and Statistical Journal” was published in Worcester from 1828 to 1832. It is in the Worcester Public Library, and has been examined for me by Mr. Towndrow. Three volumes only appeared: Vol. I., 1828-29; Vol. II., 1830-31; Vol. III., 1831-32. The first volume only contains any matter germane to the Botany of the County of Worcester.

No. 1 (August, 1828) contains an essay on the “Medical Topography of Worcestershire,” which appears, however, to be restricted to the neighbourhood of Malvern. The author, whose name is not given, states that “specimens of *Genista anglica*, *Ononis arvensis*, *Ulex europæus* and *nanus* (*Gallii*) are scattered about the hills; but, excepting the Grasses, the Ferns are by far the most abundant plants, filling the valleys, while the Dwarf Fern (*Polypodium vulgare*?) gives a green covering to the rocks; the *Viola tricolor* flowers in abundance.” He further remarks that “the plants which seem to have claimed these hills as their own, are the *Digitalis purpurea*, of which a white variety is often met with, and the *Hyoscyamus niger*, very abundant on the North Hill.” appearing whenever the soil is disturbed. The author next gives a short list of plants, copied in the main from previous writers, as obvious errors are repeated, but containing, *inter alia*, *Acer campestre* and *Acer Pseudo-platanus*. He concludes by saying that “in some parts of the Hilly Limestone country we occasionally meet with the *Potentilla verna*, more particularly in the neighbourhood of Malvern. Some of the

rarer species of *Orchis* are also found in the Limestone hills, as *Orchis ustulata* on the Abberley Hill."

Vol. I., No. 2, the number for November, 1828, contains, p. 100-105, an essay entitled "Some Observations on the Coal District of Worcestershire, and on the Botanical and other Peculiarities of the Malvern Hills," by J. K. Walker, M.D., Huddersfield. After some general remarks on the vegetation of the Malvern Hills, the writer says:—Your last number enumerates some of the rarer plants growing here, to which I beg to add the following list, according to the specimens now lying before me. They were all collected between three or four miles of the Holywell:—

† *Papaver*. (*No species mentioned*.)

* *Chelidonium majus*.

* *Fumaria (Corydalis) claviculata*.

* *Reseda Luteola*.

Cistus Helianthemum (Helianthemum Chamæcistus).

† *Polygala vulgaris*.

It is doubtful whether this is P. vulgaris or P. depressa.

Silene inflata.

Lychnis Flos-cuculi.

Spergula arvensis.

Arenaria (Spergularia) rubra.

* *Hypericum perforatum*.

* *H. humifusum*.

H. pulchrum.

H. hirsutum.

* *H. montanum*.

* *Malva moschata*.

* *M. rotundifolia*.

Geranium pusillum.

G. Robertianum.

Oxalis Acetosella.

Lotus corniculatus.

Vicia Cracca.

V. sepium.

V. sativa.

Lathyrus pratensis.

Spiræa Ulmaria.

* *Agrimonia Eupatoria*.

* *Sanguisorba officinalis*.

Geum urbanum.

* *Sedum album*.

* *Cotyledon Umbilicus*.

* *Galium verum*.

* *Scabiosa succisa*.

† *Senecio* (2 species).

Solidago Virg-aurea.

Campanula rotundifolia.

* *C. patula*.

* *Chironia (Erythraea) Centaurium*.

* *Chlora perfoliata*.

* *Verbascum Th.* (*probably Thapsus*).

Scrophularia nodosa.

* *Digitalis purpurea*.

* *Antirrhinum Linaria (L. vulgaris)*.

* *Veronica serpyllifolia*.

* *V. Chamædrys*.

* *V. Anagallis*.

* *V. Beccabunga*.

* *Euphrasia officinalis*.

Rhinanthus (Crista-galli).

* *Verbena officinalis*.

* *Thymus Serpyllum*.

* *Glechoma hederacea*.

* *Marrubium vulgare*.

Betonica officinalis.

Galeopsis Ladanum.

* *Teucrium Scorodonia*.

† *Myosotis*. (*No species mentioned*)

* *Cynoglossum officinale*.

Anagallis arvensis.

Euphorbia Peplus.

*S. arvensis.**Humulus Lupulus.** *Pyrethrum Parthenium.** *Tamus communis.**Achillea Millefolium.*† *Gnaphalium luteo-album.* *Must be an error.*

The first two numbers of the "Reporter" appeared in the same year, 1828, as Wm. Ainsworth's list in the Edinburgh Philosophical Journal. I am uncertain which of the two is entitled to precedence. The anonymous author in August, 1828, gives *Ulex europæus* and *Ononis arvensis*, also noted by Ainsworth; J. K. Walker, in November, 1828, gives *Helianthemum Chamæcistus* (*H. vulgare*, Gaert) and *Campanula rotundifolia*, also noted by Ainsworth.

Spergularia rubra, *Hypericum pulchrum*, *Geranium pusillum*, *Spiræa Ulmaria*, *Solidago Virg-aurea*, *Betonica officinalis*, in Mr. Walker's list, take precedence of the same plants in Mr. Lees's list in Loudon's Magazine, 1830.

Geranium Robertianum, *Anagallis arvensis*, *Humulus Lupulus*, take precedence of the same plants in Scott.

The 2nd number of the "Reporter" contains at p. 105, the following interesting note on the *Atropa Belladonna*, by James Nash, M.D., Worcester:—

"I beg leave to state . . . that the *Belladonna* has grown and flourished upon an old wall, formed of broken pieces of red sandstone and iron dross, in the village of Lincomb, in the parish of Hartlebury, ever since the recollection of the principal inhabitants, and I have no doubt of its genuine wildness."

A serial, entitled "The Worcestershire Miscellany," edited by Mr. Edwin Lees, was published at intervals from March, 1829, to March, 1830. Five numbers only appeared, which were afterwards collected and a supplement and preface added in 1831. A few plants from the Malvern Hills and the following plants from Perry Wood, near Worcester, are noticed in the first number:—

* *Rhamnus catharticus.** *Circæa lutetiana.** *Lathyrus sylvestris.**Serratula tinctoria.** Wild Cherry (*Prunus Avium*).* *Campanula patula.** *Rosa spinosissima.** *Melampyrum vulgatum (pratense).** *R. Borreri.** *Daphne Laureola.** *Pyrus torminalis.**Betula alba.**P. communis.**Populus tremula.**P. Malus.*

Serratula tinctoria and *Populus tremula* take precedence of the records in Scott.

Cochlearia groenlandica, mentioned among the Malvern plants, as growing on a marshy tract, somewhere on the North Hill, is probably an error, as it is not acknowledged in the "Botany of Worcestershire."

The "Illustrations of the Natural History of Worcestershire," by the late Sir Charles Hastings, M.D., published in 1834, contains an introductory lecture delivered by him to the Worcestershire Natural History Society, an account of the proceedings at the first anniversary meeting of the Society, held on the 16th May, 1834, and several appendices. Among the latter are: Appendix C, a "Catalogue of some of the rarer Lepidopterous Insects found in Worcestershire," and Appendix D, a "Catalogue of some of the most remarkable and interesting plants indigenous to Worcestershire, with their habitats," both the work of Mr. Edwin Lees. The last mentioned Catalogue, pp. 147-180, contains notices of the principal authorities for the Botany of the County, and a list of 388 species, with their habitats. Many of these are old records by Nash, Stokes, Withering, Purton, and Scott. Others were supplied by contemporary botanists, among whom Dr. Streeten, a physician then practising in Worcester, was a large contributor. Mr. Lees's own name is affixed to many of the records. As to the remainder, which are vouched by no authority, it is not always easy to tell whether they are given on that of Mr. Lees himself or are reproductions from other writers. In many instances the former is certainly the case, in other instances, almost certainly the latter. Perry's list appears to have escaped Mr. Lees's attention. Some Hereford and Gloucester records are included, without any notice that they do not belong to Worcester.

In the following reprint of the Catalogue I have omitted all the species given only on the authority of earlier writers. The plants previously noted by Mr. Lees in the *Strangers' Guide* are marked with the letters S.G.; those in *Loudon's Magazine* by the letters L.M.

Edwin Lees, in Hastings's "Illustrations of the Natural History of Worcestershire," 1834:—

- * *Clematis Vitalba*, 167. Abundant about Ankerdine Hill and Malvern. Also in the hedges at Powick.
- * *Thalictrum flavum*, 167. Eastern side of Pitchcroft, banks of the Severn, &c.
- * *Ranunculus Lingua*, 167. The late Mr. T. B. Stretch, a Worcester botanist, records having found it in Ockerley (*Ockeridge*) Wood, Holt. S.G.
- * *R. parviflorus*, 167. Under hedges by the road side, near the Virgin's Tavern, Worcester. Also at Hallow, Cotheridge, Alfrick, and Malvern, in considerable plenty. L.M.
- † *Trollius europæus*, 167. Moist meadows at the foot of Bredon Hill. *Must be an error. The species is not noticed in Mr. E. Lees's Botany of Worcestershire, 1867.*

- * *Aquilegia vulgaris*, 167. In Bewdley Forest, Shrawley Wood, and about Leigh Sinton. The smaller variety, *A. alpina*, of Hudson, on Bromsgrove Lickey. Dr. Streeten. S.G. *Aquilegia alpina*, *Linu.*, is mentioned by Hudson as growing in Westmoreland. *Fl. Ang.*, 1st Ed., p. 208; 2nd Ed., p. 235. Dr. Streeten must have been mistaken in referring the Lickey plant to this species. The Columbine has not been seen at the Lickey for many years. L.M.
- * *Delphinium Consolida* (*D. Ajacis*), 167. Near Grimley. Mr. Edmunds.
- Berberis vulgaris*, 160. In a hedge by the side of Comer Lane.
- Nymphæa alba*, 166. In the Avon, under Littleton Bank, according to Mrs. George Perrott.
- * *Nuphar lutea*, 166. Abundant in the tributaries of the Avon, and in various brooks and pools.
- * *Papaver somniferum*, 166. Severn side below Worcester Bridge. S.G.
- * *Fumaria* (*Corydalis*) *lutea*, 171. Found by Mr. Lees in a shady lane below Abberley Church, not in the immediate vicinity of any garden, but probably naturalised.
- * *F.* (*Corydalis*) *claviculata*, 171. Abundant among the loose stones on the declivities of the Malvern Hills. L.M.
- * *F. capreolata*, 171. In a hedge at Shrawley and near Abberley.
- * *Cardamine amara*, 170. Below Worcester, in a willowy spot at the Ketch, close to the Severn. Mr. Lees. S.G.
- * *C. impatiens*, 170. Western side of the Severn, below Worcester Bridge. Also in Shrawley Wood and on Rosebury Rock.
- * *Nasturtium sylvestre*, 170. On the banks of the Severn, at Worcester, most abundantly.
- * *N. amphibium*, 170. In ditches by the side of Pitchcroft.
- * *Turritis glabra*, 171. Near an old sandstone quarry between the Mitre Oak and Stourport. Messrs. Walcot and Lees.
- Cochlearia Armoracia*, 169. On the banks of the Severn, truly wild.
- Alyssum maritimum*, 169. Once found growing on the west bank of the Severn, below Worcester bridge, by Mr. James Goodman.
- * *Teesdalia nudicaulis*, 169. Abundant on Hartlebury Common, and at the Giant's Grave, Habberley. Mr. Lees.
- * *Reseda Luteola*, 164. In waste places about Grimley, Leigh Sinton, &c. Growing luxuriantly on a wall bounding Angel Street Cemetery, Worcester.
- * *Cistus Helianthemum*, 167. (*Helianthemum Chamæcistus*, *Mill.*) Abundant on the Malvern Hills and Bredon Hill. Also on dry banks at Alfrick, Clifton-on-Teme, Crowle, &c. L.M.
- Viola palustris*, 155. On Hartlebury Common.
- V. hirta*, 155. Lane leading from Kempsey to Green Street. Dr. Streeten.
- * *Drosera rotundifolia*, 159. Bog at the base of the Worcestershire Beacon, Malvern. Hartlebury Common, Bromsgrove Lickey. L.M.

(To be continued.)

MR. HERBERT SPENCER.—This distinguished philosopher completed his 68th year on Friday, 27th April last, having been born at Derby in 1820. At a meeting of the Sociological section of the Birmingham Natural History and Microscopical Society, held on Tuesday, 24th April, on the motion of Mr. W. B. Grove, B.A., President of the Society, seconded by Mr. W. R. Hughes, F.L.S., President of the section, a resolution of congratulation was unanimously passed on the occasion, and Mr. F. G. Cullis, F.G.S., the Hon. Secretary, was requested to communicate it to Mr. Spencer.

A NEW ILLUSTRATED MANUAL OF BRITISH BIRDS.*

It gives us much pleasure to draw attention to a new book about British birds, which, so far as the first part enables us to judge, will supply a long felt want. It is to be issued in about twenty monthly shilling parts, each containing forty pages and twenty illustrations. The latter will be mostly the same as the wood cuts in the fourth edition of "Yarrell's British Birds," the general excellence of which is so well known as to render praise of them quite superfluous. When completed the volume will contain nearly 800 pages, and will provide a convenient illustrated hand-book, embodying concise descriptions of the geographical distribution, habits, nesting, plumage, and in fact all other needful information, which can be compressed into the allotted space, of all our British birds. Two pages will be given to each species, inclusive of the illustrations, of which there will be more than 350. The author is Mr. Howard Saunders, F.L.S., F.Z.S., editor of the third and fourth volumes of the last (fourth) edition of "Yarrell's British Birds." This book promises to be of great use to young ornithologists, and will, we do not doubt, find a place in the libraries of all who desire to possess a reliable book about British birds, but who cannot afford to buy the more costly books, which, until now, have been the only ones on the subject worth possessing. To enable our readers to judge for themselves, we subjoin one of the descriptive articles from the first part, with its illustration, for the use of which we are indebted to the courtesy of the publishers. We warmly recommend this new manual to all who are interested in ornithology:—

* "An Illustrated Manual of British Birds," by Howard Saunders, F.L.S., F.Z.S., &c. In monthly parts. Price 1s. London: Gurney and Jackson (successors to Mr. Van Voorst).



THE MISSEL-THRUSH.

TURDUS VESCIVORUS, Linnæus.

“The Missel-Thrush, the largest indigenous species of the genus, has, owing to the increase of plantations during the present century, extended its breeding-range northward to Caithness and Sutherland, and to most of the Hebrides; though to the Orkneys it is only a straggler, and has not yet been recorded from the Shetlands. Unknown in Ireland until about the year 1800, it is now a resident and increasing species there; while in England and Wales it is of general distribution, being commoner in the wooded districts. Migration takes place from the colder portions of our islands in autumn and winter, when large flocks arrive from the Continent.

It breeds from Bodö in Norway southward, throughout the suitable portions of temperate Europe to the extremity of the Spanish Peninsula, and even in Northern Africa; eastward, in Turkey, the Caucasus, the mountain forests of Asia Minor, Turkestan, and the north-western Himalayas up to 9,000 feet: in the latter it attains its palest colour and largest dimensions, and was formerly distinguished as *T. Hodgsoni*. In temperate Siberia it is found eastward to Lake Baikal; migrating in winter to Northern India, Persia, and Africa north of the Sahara.

In the south of England the Missel-Thrush sometimes begins to breed in February, and even in the north it frequently has eggs in March. The nest, which when placed in a wide fork of a tree has a considerable foundation of mud, is lined with dry grasses and composed

externally of bents and lichens, but although the colour of the latter may resemble that of the branch on which the structure is placed—bushes being seldom resorted to—there is often no attempt at concealment. The eggs, 4-5 in number, are greenish to tawny-white, blotched with reddish-brown and lilac: measurements about 1.25 in. by .85 in. In the south two broods are generally produced annually, but in the north the fine weather is too short for more than one. From its habit of singing early in the year in defiance of rough weather, the Missel-Thrush is often called the ‘Storm-cock’; also the ‘Holm-screech,’ from its partiality to the berries of the Holm or Holly, and its harsh *churr*-ing note. Its trivial name is probably a contraction of Mistletoe-Thrush, owing to a widely-spread belief in its predilection for the berries of that parasite; but in Great Britain its food consists rather of berries of the yew, holly, mountain-ash, hawthorn, ivy, &c., fruit when obtainable, worms, snails and insects. Although shy of man, except when its nest is approached, the Missel-Thrush is bold and tyrannical towards other birds, fearlessly attacking Magpies, Jays, and other species superior to it in size; and occasionally it has even been known to carry off nestlings. Its flight is rapid but jerky, and on the wing its large size and generally *grey* appearance serve to distinguish it from any other Thrushes.

Adult male: upper parts ash-brown; under parts buffish-white, with bold fan-shaped spots, smaller and more arrow-shaped on the throat; under wing-coverts and axillaries pure white; bill horn-brown, yellowish at the base; legs pale brown. Length about 11 in.; wing from the carpal joint 5.75 in. The female is slightly paler than the male. In the young the arrow-shaped markings on the throat and breast are more pronounced; the upper wing-coverts broadly tipped with white, and the under parts, especially the flanks, suffused with golden-buff. In this plumage it has been mistaken for the rare White’s Thrush, but its *twelve* tail-feathers distinguish it.”

THE FLORA OF WEST YORKSHIRE.*

“The Flora of West Yorkshire” has been long looked for; and the high botanical reputation of its author, together with the peculiar features of the district whose flora it records, have given rise to expectations of something more than ordinary. It is not saying too much to say that in the work before us these expectations are fully realised, nor is it flattery to say that it is one of the completest and most ably compiled of our local floras. Like Purton’s classic “Midland Flora,” it embraces the whole range of systematic botany, from the conspicuous phanerogam to the little known and less heeded diatom. It has, however, an advantage over “The Midland Flora” in not being an attempt of one mind to grasp and work out a number of diverse and difficult branches of botanical science, but in each of the special groups, such as mosses, lichens, fungi, &c., Dr. Lees has had the able help of specialists; hence each branch has been well worked and fully

* “The Flora of West Yorkshire,” by F. Arnold Lees, M.R.C.S. Eng. 8vo. Lovell Reeve and Co., pp. 843. Coloured map of the district.

recorded, and the names of the recorders are a sufficient guarantee for the correctness of the record. After some introductory remarks under the title of "Foreword," the work opens with a well-written chapter on "Climatology," treating of many and varied subjects in connection therewith, such as, position as affecting climate, aerial temperature in the Riding, atmospheric humidity and rainfall, winds, temperature in relation to vegetation, climatic and botanic zones, limits and areas of the four West Yorkshire zones, and zonal range of West Yorkshire flora, all of which are ably and fully discussed, the altitude above sea level of many of the districts being given, together with many tables in illustration. This chapter closes with a table giving the altitudinal limitations in West Yorkshire for 420 selected species of the ascending group from 150 feet to 2,400 feet, and some interesting observations on the Genesis of the flora. The chapter is full of instructive interest to both botanist and general student.

The next chapter, "Lithology," which treats of the rocks and soils, and their influence on the flora of the West Riding, is well written and thoughtfully worked out, and gives abundant evidence of close and attentive study, not only of the physical features of West Yorkshire, but also of the published works of other writers, such as Thurmann and J. G. Baker, as well as of the excellent floras of Middlesex and Hants. The following are the headings of the leading paragraphs:—1. Two Great Rock Types. 2. Physical Characters of the Hills of Each Type. 3. Lithological Classification of Soils. 4. Comparisons between Thurmann's List and the Flora of West Yorkshire. 5. Botanical Features of West Yorkshire Soils. 7. Geographical Allies. A very full bibliography of the flora follows, giving data from 1548 to 1885; the introductory matter concluding with the Plan of the Flora, which gives full explanations of the classification and details of that portion of the volume.

The flora proper then follows. That devoted to flowering plants and ferns occupies 410 pages. The nomenclature and classification is mainly that of the 7th edition of the "London Catalogue of British Plants," though here and again a slight departure is made. The English name, where such exists, follows the botanical or Latin name, and, what is more interesting, we have, so far as these are known, rustic names, and these are often very expressive.

That the older authors have been carefully studied is seen by frequent quotations from their works. The quotations are fully given and the synonyms special to each author quoted. Many other details are given, such as range, upward or downward, in feet above sea level; the degree of citizenship,

such as native, casual, denizen, colonist, and the like, and followed in many instances by those pleasant critical observations which mark the work of a real student and true lover of his subject.

The Characeæ are arranged in accordance with the excellent monograph of Messrs. H. and J. Groves, and here we have records of 12 out of the 25 British species—a very full and complete list.

Bryophyta, which follows, includes a record of all the mosses and hepatics of the West Riding. This occupies 97 pages, and is probably the most extensive and complete record yet published of any British district. Among the recorders are some well-known names, such as W. Wilson, J. Nowell, J. G. Baker, and Messrs. West, Hobkirk, Slater, Barnes, Stabler, Carrington, Spruce, and Pearsal, so that some of the ablest and most reliable workers in this field of study have aided in producing this portion of the flora; hence its fulness. The only plant one misses is *Pterigynandrum filiforme*; which the writer certainly observed in Bolton Wood. The total number of mosses and hepatics recorded is 448.

The Lichens occupy twenty-nine pages, and give a record of 258 species. The classification and nomenclature is that of Leighton's "Lichen Flora of Great Britain." In these plants the records are mainly from Dr. Carrington, J. G. Baker, Bohler, West, and Stansfield. This study is one of minutiae, and requires closer investigation than most other botanical studies, hence we rarely find these plants as fully recorded as in the case of mosses, and the more conspicuous cryptogams; the district, however, seems to have been well worked, and the record is a good one.

Fungi occupy eighty pages and give a record of 1,009 species, of which 488 belong to the Hymenomycetes. Although the records of these plants date back to James Bolton, whose "History of Funguses" is now classic, and known by reputation throughout the world, little seems to have been done in the West Riding since his day, until some seven years ago the first Fungus Foray ever held in Yorkshire gave an impetus to the study. So that, while the "History of Funguses" gives the kernel to the Fungus florula, it is the work of enthusiasts during the past seven years that has supplied the main material, and the record does them great credit. Following this is the Fresh Water Algæ, revised by William West, the arrangement being that of Dr. Cooke in his recently published "British Fresh Water Algæ," this occupies thirty-two pages, and records 382 species, including the diatoms.

A copious Addenda and Omissa, which occupies thirty-seven pages, closes the work, and the following summary will show at a glance how rich a field for research is to be found in the West Riding of Yorkshire. These are:—

| | | |
|-------------------------------|--------|-------|
| Phanerogams (including Ferns) | ... | 1,044 |
| Characeæ | | 12 |
| Mosses | | 340 |
| Hepatics | | 108 |
| Lichens | | 258 |
| Fungi | | 1,009 |
| Algæ | | 382 |
| | | 3,153 |

There are three ably compiled indices, the work of Mr. W. Whitwell. These are excellent, and reflect well on the patience and thoroughness of the compiler.

In conclusion, the work is well printed, and, considering the vastness of the records, remarkably free from errata, and from beginning to end reflects the highest credit on the author.

J. E. BAGNALL.

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, B.A., AND J. E. BAGNALL, A.L.S.

In publishing this list of the Fungi of Warwickshire, our aim has been to place on record all that has been done by past and present workers in the study of the Warwickshire Hymenomycetes, so far as our knowledge extends.

The list must be far from complete, as only portions of the county have been worked, and those portions far from exhaustively.

In determining the species intended by Withering and Purton, the identifications of previous authors have not been copied; but an attempt has been made, by comparison of their descriptions, and the quoted figures, with the latest ideas of Fries, to decide what was meant by them, and we feel assured that this can be satisfactorily done in more cases than has been before imagined.

We have also availed ourselves of that extensive series of coloured illustrations of fungi from the neighbourhood of Kenilworth and Warwick which is now in the British Museum; these were executed by the late Mrs. Russell, of Kenilworth, and many of her specimens were named or confirmed by eminent authorities. We must here acknowledge our indebtedness to the late Rev. W. W. Newbould for all our

knowledge of the nomenclature and stations given on these plates. He, with kindly courtesy, and the untiring patience so peculiarly his own, without solicitation on our part, copied for us all the details we give from these. Of present workers we have to thank the Rev. D. C. O. Adams for his numerous MS. notes on the fungi found by him in the neighbourhood of Combe, Ansty, and Brinklow; Dr. M. C. Cooke for notes made during his various visits to Birmingham, and also for other kind and valuable help; and, besides him, Messrs. C. B. Plowright, M.R.C.S., of King's Lynn, and Mr. W. Phillips, of Shrewsbury. In quoting our various authorities want of space has prevented our giving the full names of our authorities or titles of works referred to, and the following will show what these abbreviations indicate:—

With.—An arrangement of British Plants. By William Withering, M.D., F.R.S. The Fungi in Volume IV., Ed. 4, 1801. Ed. 7, 1830. Unless otherwise stated, Ed. 4 is the one intended.

Purt.—A Botanical description of British Plants in the Midland Counties. By Thomas Purton, Surgeon, Alcester. Vol. II., 1817.

An appendix to the Midland Flora, 1821.

Bloxam.—Manuscript notes by the late Rev. Andrew Bloxam, of Twycross, in his copy of the 5th volume of English Flora in our possession.

Russell, Illustr.—A series of coloured Illustrations of the Fungi around Kenilworth and Warwick. By the late Mrs. Russell, of Kenilworth, now in the British Museum.

Russell, List.—A printed List of the British Fungi, marked by the late Mrs. Russell, lent by her niece, Miss Worsley.

Rugby School Rep.—Report of the Rugby School Natural History Society, 1886.

Adams.—Rev. D. C. O. Adams, M.A., of Ansty, near Coventry. MS. Notes.

Perceval.—List of Fungi found in the neighbourhood of Warwick, between October, 1871, and October, 1872, by Cecil H. S. Perceval, Esq.

Cooke's Illustr.—Illustrations of British Fungi (Hymenomycetes). By Dr. M. C. Cooke.

The mark (!) after any locality denotes that it has been seen by one of us in that same place; the same mark after the name of an authority, that we have seen the specimen referred to.

Order I.—AGARICINI.

Genus I.—AGARICUS.

Sub-genus I.—AMANITA.

1. *Ag. phalloides*, *Fr.* *Ag. muscarius*, var. 5, *stramineus*, *Purt.* Woods and fields. Aug.-Sept. Ragley and Oversley Wood, *Purt.* iii., 203. Kenilworth, *Russell, List.* Warwick, *Perceval.* Combe Ridings! *Adams.*

Pool Hollies Wood, Sutton; Trickley Coppice, and New Park, Middleton; Edgbaston Park; Packington Park; Cut Throat Coppice, Solihull; Crackley Wood, Kenilworth; Haywood; Old Park Wood, Ragley Woods.

Var. *vernus*, Bull. *Ag. muscarius*, var. 3, *albus*, Purt. Woods and heaths, rare, Oversley, *Purt.* iii., 201. Combe Ridings, *Adams*. New Park, Middleton; Marston Green; Coleshill Pool; copse, by Plant's Brook Reservoir.

The plants from Oversley and Marston Green, at least, are probably the *albus* form of *Ag. phalloides*.

2. *Ag. Mappa*, *Fr.* Woods, &c. Sept.-Oct. Rare. Birmingham Road, Kenilworth, *Russell, Illustr.* Combe Ridings, *Adams*. Sutton Park; Trickley Coppice; Shawberry Wood, Shustoke.

3. *Ag. muscarius*, *L.* Woods and heathy footways, Aug.-Sept. Frequent. Edgbaston! *With.*, 182. Oversley Wood, *Purt.* ii., 630. Crackley Wood, *Russell, Illustr.*, Combe Woods; Allesley; *Adams*. Oscott College Grounds; Trickley Coppice, and New Park, Middleton; Sutton Park; Langley; Coleshill Heath; Marston Green; Edgbaston Park; Shustoke.

Var. *puella*. *Ag. muscarius*, var. 4, *Purt.* Ragley Woods, *Purt.* iii., 202. Trickley Coppice. Sometimes as large as type.

4. *Ag. pantherinus*, *DC.* *Ag. muscarius*, var. 2, *Purt.*, *ex part.* Oversley Hill; Coughton Park; *Purt.* iii., 201. Sutton Park; the Spring, Kenilworth; Alveston Pastures.

5. *Ag. excelsus*, *Fr.* Woods. Kenilworth, *Russell, List.*

6. *Ag. rubescens*, *Pers.* *Ag. muscarius*, var. 7, *With.* Woods and open places. Common. Edgbaston Park, where grass had been mown, *With.*, 183. Crackley Wood, *Russell, Illustr.* High Wood, Combe, *Adams*. Warwick, *Perceval*. Sutton Park; New Park, Middleton; Bradnock's Hayes, near Sutton; Ham's Hall; pine wood, near Coleshill; Coleshill Pool; Packington Park; Marston Green; Hampton-in-Arden; Solihull; Knowle; Kingswood; Berkswell; the Spring, Kenilworth; Ragley Park.

7. *Ag. nitidus*, *Fr.* Woods. Rare. Sept.-Oct. Coleshill Pool. *Ag. muscarius*, var. 2, *With.*, 182, Edgbaston, is either this or *Ag. Mappa*.

8. *Ag. asper*, *Fr.* Woods. Aug.-Oct. Rare. Crackley Wood? Birmingham Road, Kenilworth? *Russell, Illustr.* Sutton Park? Packington Park; Coleshill Pool; Shepherd's Wood, near Solihull.

9. **Ag. vaginatus**, *Bull.* (*Ag. muscarius*, var. 6, *plumbeus*. With., *Purt.*) Woods and pastures. Common. Sept.-Oct. Pastures, Edgbaston; Edgbaston Park! *With.*, 240, 268, Wood, near Pophills, *Mrs. Rufford*, *Purt.* iii., 203. Kenilworth! *Russell*, *List.* Ansty, *Adams*. Sutton Park; Windley Pool, Four Oaks; Trickle Coppice; Middleton; pine wood, near Coleshill; Coleshill Pool, Water Orton; Ham's Hall; Marston Green; Haywood; Ragley Wood; Arrow; Alveston Pastures.

The varieties *fulvus* and *lividus* both occur, the former more commonly and usually smaller.

Ag. strangulatus, *Fr.* A single specimen, probably belonging to this species, has occurred at Ham's Hall.

(To be continued.)

THE MIDLAND UNION OF NATURAL HISTORY AND MICROSCOPICAL SOCIETIES.

The arrangements for the Annual Meeting at Northampton are in an unusually advanced state, and we are able to give our readers an outline of the proposals of the host society, the Northamptonshire Natural History Society and Field Club, as submitted to the Executive Committee of the Union at a meeting on Wednesday, April 25th. The date fixed for the Annual Meeting is Wednesday and Thursday, July 4th and 5th. The Right Hon. Earl Spencer will be President, the Annual Meeting itself being held in the Town Hall at the usual time on Wednesday afternoon. The address, in place of one by the President, will be delivered by the Rev. H. H. Slater, F.Z.S., the well-known ornithologist, upon some ornithological subject not at present fixed. After the meeting there will be a party to visit the principal Churches of Northampton, conducted by the Rev. T. C. Beasley, Secretary of the Architectural Society of Northampton, and in the evening there will be a conversazione in the Town Hall. Arrangements have been made to hold this in conjunction with the annual meeting of the Northampton Architectural Society, and papers will be read by C. A. Markham, Esq., Sir Henry Dryden, and others. On this first day of the meeting a luncheon will be provided for the Council, members of the Union, &c., in the middle of the day.

On Thursday there will be three excursions. (1) The members of the Union will be permitted to join the annual excursion of the Northampton Architectural Society, under the leadership of Sir Henry Dryden, to the most famous Churches of the neighbourhood; (2) a Geological excursion, visiting some

of the sections in the neighbourhood of Northampton, specially including the Upper Lias, Inferior and Great Oolite, &c.; (3) a Botanical excursion to Fawsley Park, Badby Woods, and Daventry, in the course of which it is hoped to visit the grounds of E. G. Loder, Esq., including his famous Alpine and Winter Gardens, &c.

Further particulars of these arrangements will be given hereafter, but enough has been said to show that Northampton has determined to improve upon the high reputation it acquired during the last visit of the Union.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—**GEOLOGICAL SECTION**, March 20th. Mr. T. H. Waller, B.A., B.Sc., in the chair; forty-three members and friends present. Professor Hillhouse exhibited two examples of Antipodal Culture of Hyacinths, consisting of four bulbs planted in vases; two bulbs in each vase, one erect at the top, the other inverted towards the bottom. The bottom bulb in each case had grown downwards into the water, and one had flowered in the water. Mr. Chas. Pumphrey exhibited, by the oxy-hydrogen lantern, a fine series of photographic views (geological and others), taken by himself in parts of Switzerland and Germany, including Dover Cliffs, Falls of the Rhine, The Rigi, "The Catastrophe at Zug," Valley of Engelberg, Engelberg Water Falls, Brünig Pass, Upper and Lower Glaciers of the Grindelwald, the Wetterhorn, and many others of considerable interest and beauty. A cordial vote of thanks was given to Mr. Pumphrey for his kindness in exhibiting these views and so clearly describing them.—**BIOLOGICAL SECTION MEETING**, held April 10. Mr. R. W. Chase, F.L.S., in the chair. The following were exhibited by Mr. W. H. Wilkinson:—A collection of Lichens, from South Devon, including the rare *Parmelia acetabulum*, rare *Lecanora ferruginea*, *L. parella*, *Lecidea canescens*, *Placodium murorum*, &c. By Mr. W. B. Grove. B.A.—Fungi: *Peziza nivea* and the rare *Triposporium elegans*, both from Hopwood Dingle. By J. E. Bagnall, A.L.S., a number of Mosses, Hepatics, and Lichens, from the Warwickshire Stour Valley, including *Orthotrichum cupulatum* and *Didymodon sinuosus*, both new to the district, and *Orthotrichum obtusifolium*, *Cryphaea heteromalla*, rare, &c.; for Fred. Enock, F.E.S., a series of fourteen sketches of insect preparations, No. 11. being specially noticeable. This is a longitudinal section through a fully grown impregnated garden spider, *Epeira diadema*, showing all the organs which lie in the line of section, an instructive as well as most beautiful preparation. Mr. W. P. Marshall having taken the chair, Mr. R. W. Chase then gave his paper, "Notes upon Birds which have become extinct, and those species which are likely to become so in Great Britain; illustrated by a series of Photographs of Eggs of the Great Auk, *Alca impennis*." This paper was one of great interest, and was illustrated by life-size photographs of most of the existing eggs of the species, seventy-seven in number, all being kindly lent for the occasion by Mr. E. Bidwell; also by clutches of eggs of allied species, and specimens of the Razor Bill and Small

Auk. A discussion followed, which was ably sustained by Mr. G. A. Panton, F.R.S.E., who gave much interesting information from personal knowledge; also by Mr. W. P. Marshall, and Mr. W. H. Wilkinson. Mr. Chase's paper will be published in due course in the "Midland Naturalist."—SOCIOLOGICAL SECTION. At the ordinary meeting on Tuesday, January 24th, Mr. W. R. Hughes, F.L.S., in the chair, a paper was read by Mr. A. Browett on the eleventh and twelfth chapters of Mr. Herbert Spencer's "Data of Ethics," viz.:—"Egoism *versus* Altruism" and "Altruism *versus* Egoism." On the proposition of Mr. Browett, seconded by Mr. W. B. Grove, B.A., Mr. W. R. Hughes, F.L.S., was re-elected President of the section, and Mr. F. J. Cullis, Hon. Sec.—At a supplementary meeting, Thursday, February 18th, Mr. W. R. Hughes, F.L.S., in the chair, the Hon. Sec., Mr. F. J. Cullis, continued the reading of Mr. Herbert Spencer's essay on "The Genesis of Science."—At the ordinary meeting, Tuesday, February 28th, Mr. W. R. Hughes, F.L.S., in the chair, a paper was read by Mr. W. K. Parkes on the thirteenth and fourteenth chapters of Mr. Spencer's "Data of Ethics," entitled respectively "Trial" and "Compromise," and fourteen members were present.—At a supplementary meeting, Thursday, March 1st, Mr. W. R. Hughes, F.L.S., in the chair, a paper was read by Professor Allen on Mr. Herbert Spencer's essay on the "Origin and Function of Music," contrasting the views of Mr. Spencer with those of Mr. C. Gurney, illustrating his positions by the use of a piano and a series of tuning forks. An animated discussion followed, in which the President, Mr. Stockley, Mr. Allison, Mr. W. B. Grove, B.A., and Mr. Cullis took part. There were twenty-six members and friends present. The proceedings terminated with a hearty vote of thanks to Professor Allen.—At a supplementary meeting, Thursday, March 22nd, Mr. W. R. Hughes, F.L.S., in the chair, a paper was read by the President, opening the study of Mr. Herbert Spencer's "First Principles," after which he read and discussed the first chapter on "Religion and Science."—At the ordinary meeting, Tuesday, March 27th, Mr. J. Levick in the chair, a paper was read by Mr. W. K. Parkes on the last two chapters of Mr. Herbert Spencer's "Data of Ethics," treating of "Absolute and Relative Ethics," and "The Scope of Ethics."—At a supplementary meeting, Thursday, April 5th, Mr. W. R. Hughes, F.L.S., in the chair, a paper was read on the second and third chapters of Mr. Herbert Spencer's "First Principles," dealing with "Ultimate Religious Ideas" and "Ultimate Scientific Ideas."—At a further supplementary meeting, Thursday, April 19th, Mr. W. R. Hughes, F.L.S., in the chair, an exposition of the fourth chapter of Mr. Herbert Spencer's "First Principles" was given by Mr. W. B. Grove, B.A., entitled the "Relativity of all Knowledge." Eleven members were present.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—February 20th. Special: Geology. Mr. J. Moore exhibited specimens of Trilobites, Ammonites, etc., from the Cambridge Greensand; Mr. J. Collins, specimens of *Limnea peregra* from an Irish peat bog, thirty feet from the surface, apparently identical with present forms; Mr. Corbet, a collection of minerals and ores from North Wales; Mr. Madison, fossils from the Tertiary beds, Isle of Wight; Mr. A. T. Evans, fossiliferous pebbles from the Drift, and a pebble of spherulitic rhyolite from the same deposit. Under the microscope Mr. J. W. Neville showed a section of Arran Pitchstone; Mr. H. Hawkes, concepticle of *Fucus serratus* and other algæ.—February 27th.

Mr. C. P. Neville exhibited marine shells from Sydney; Mr. J. Madison, specimens of *Bulimus detritus* from Switzerland; Mr. Camm, *Trichina spiralis* in rat's tongue. Then followed a paper on "A Conchological Ramble in South Wales." The ramble was from Caermarthen up the country to the lakes in the Black Mountains, on the border of Brecknockshire, to search one of the lakes, Llyn-van-fach, for specimens of *Limnæa peregra* var. *Burnetti*, said to be found there. The route was described and the various shells met with on the way, and the position and scenery of the lakes and their surroundings with the shells found in them. The journey was a successful one and yielded specimens of the shell sought. The return was made by way of Swansea. The shells collected in the ramble were exhibited.—March 5th. Mr. Bennett showed differently coloured sands from Alum Bay, Isle of Wight. Under the microscope, Mr. Camm, *Carchesium polypinum*; Mr. J. W. Neville exhibited foraminifera from Jersey, and called attention to the resemblance they bore in form and texture to those derived from the Cambridgeshire silt.—March 12th. A lime-light lantern exhibition of natural history objects. The President in the chair. The President showed a series of photographs of rock sections, pointing out the various inclusions in rocks and how such inclusions arose; Mr. J. W. Neville, a series of illustrations of Rhizopods, Rotifers, and Polyzoa; Mr. O. Hutchinson, photo-micrographs of rocks, sections, and diatomaceæ; Mr. W. Tylar, rural scenery, hedgerows, frost effects, etc.; Mr. Delicate, photographs of the rocks and caverns of the Wren's Nest; Mr. C. Pumphrey, photographs of flowers; Mr. J. Edmonds, photographs of animal and vegetable tissues, illustrations of pond life, and some miscellaneous views.—March 19th. Subject: "Object Mounting and Section Cutting." Mr. Delicate gave some useful hints on the mounting of animal and vegetable tissues in Deane's gelatine. Mr. H. Hawkes described the usefulness of glycerine as a mounting medium, and the class of objects best adapted for it. The chief difficulty in its use was in the ringing, but this had been overcome by the use of gum damar dissolved in benzoline, instead of the usual gold size. Mr. J. W. Neville described the preparation and mounting of insects in balsam. A collection of slides was exhibited to illustrate each process.—March 26th. Mr. J. Edmonds gave a lecture on "Photo-Micrography Simplified." The speaker said his object was not so much to show the best way of accomplishing the end in view as the simplest and least expensive one. Though the visual and actinic rays of light did not focus exactly on the same plane, yet in practice he had found an ordinary microscopic object glass capable of producing good pictures. The camera was dispensed with, and the image formed by an object glass fixed in the microscope stand thrown on a moveable screen. The simplicity of the arrangement was much admired. During the evening a negative was taken that gave every satisfaction, and showed how readily a microscopist could produce permanent records of his studies.—April 9th. Mr. J. W. Neville exhibited specimens of *Trinucleus concentricus*, a trilobite from the Mid-Bala shales; Mr. Deakin, a collection of fossils from the fluvio-marine beds of the Eocene formation, Isle of Wight; Mr. Hopkins, specimens of *Helix aspersa*, showing umbilicus; Mr. J. Collins, specimens of *Ostrea expansa* and other fossils from Portland; Mr. Hawkes, a collection of marine algæ, including specimens of *Ptilota elegans*, with tetraspores and *Sphærococcus coronopifolius*. Under the microscopes Mr. Hawkes showed a series of preparations of algæ; Mr. J. Collins, *Ceramium nodosum*.

THE PRESENT AND FUTURE OF SCIENCE
TEACHING IN ENGLAND;
WITH SPECIAL REFERENCE TO BOTANY.

ADDRESS TO THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL
SOCIETY, AS RETIRING PRESIDENT, BY

W. HILLHOUSE, M.A., F.L.S.

(PROFESSOR OF BOTANY AND VEGETABLE PHYSIOLOGY, MASON SCIENCE
COLLEGE, BIRMINGHAM).

(Continued from page 120.)

But time warns me that I must pass away from the school, in order briefly to consider the position of affairs in higher teaching; here, however, confining my attention mainly to the subject of Botany.

From a botanical point of view the last fifteen years or so, so fraught with great results in our national education movement, are specially marked by three important changes. The first of these is the rise of a new subject of education, or rather of a systematic combination of portions of three old subjects, to which the name of "Biology" is given. Professor Huxley, who must be looked upon as the founder of this new teaching, thus explains his position in the preface to his "Course in Practical Biology," 1875:—"I arrived at the conviction that the study of living bodies is really one discipline, which is divided into Zoology and Botany simply as a matter of convenience, and that the scientific zoologist should no more be ignorant of the fundamental phenomena of vegetable life, than the scientific botanist of those of animal existence." Again, more recently (November, 1887), in a new edition of the same work, he says:—"No man can be competent to deal with the greater problems of Biology as they are now presented to us, unless he has made a survey, at once comprehensive and thorough, of the whole field of biological investigation. The animal and the vegetable world are only two aspects of the same fundamental series of phenomena, and each is capable of throwing a flood of light upon the other." This assertion of the unity of life is, I venture to think, one of the greatest features of Huxley's life work. Biology, as taught by Professor Huxley, consisted in the successive study, structural and functional, of a small number of selected plants and animals, used as "types." Commencing with yeast and *Protococcus* on the one hand, and *Amœba* on the other, as illustrating some of the simplest phases of plant and animal life respectively, it progressed by greater

or lesser jumps to the fern and bean plant on the one side, and the frog on the other. I do not now express any opinion as to the relative advantages and disadvantages of this method of type-teaching, nor is it easy to come to any definite conclusion thereon at all, although I systematically practise both methods of teaching.

The second of the great changes is the enormous amplification in the scope of botanical teaching, due, there can be no doubt, to the publication of the "Lehrbuch der Botanik" of Professor Sachs, in 1872, and its translation into English in 1875. It is well-nigh impossible to estimate at its due value the influence of this grand work upon the formation of the modern school of English botanists. From it the teaching of Cambridge took its inspiration, and to Cambridge four-fifths of the teachers of the new school owe their training.

The third change referred to is the gradual decadence, and final excision, of Botany, as a subject essential to the training of every medical man. This change, which has come into operation for the conjoint Colleges of Physicians and Surgeons of London, and the Universities of Cambridge and London,—the largest medical examining bodies in the kingdom,—has been due largely to the desire to contract the scope of the student's work, and partly to more strictly scientific reasons, since in the Universities of Cambridge and of London "Biology" has replaced it as an examination subject. With this alteration, *per se*, I have here, of course, nothing to do, but I must in passing be allowed to touch upon one or two principles which I think ought clearly to underlie the training for any such profession as that of medicine. It must be borne in mind that the medical man has rights and powers conferred upon him by statute; that the life, health, and, in some degree also, the reputation of his patient are entrusted to him, and that the patient cannot reasonably be expected to accurately gauge the extent of his professional adviser's ability. He has, in fact, largely to be taken on the faith of what examinations and the statute represent him to be. The public, then, has a right to demand that no misplaced leniency shall turn adrift upon it men who have not been tested in the most stringent manner. The work of the doctor cannot be tested like the work of the carpenter; the fact of being a medical man should carry with it its own evidence of skill. Further, the medical man differs from the quack only in that his methods are scientific and not empirical, and the public, therefore, has a right to ask that his education shall be based upon the soundest possible scientific training; and that, as his profession is not chemical

or physical but biological, so Biology should form an inherent and all important part of his preliminary training. The third of my principles is this:—In any education spreading over a term of years, including a series of steps, each of which has to be successfully taken before arriving at a definite and necessary goal, the weeding, if it has to be done at all, should be done on the very threshold. It is cruel kindness to allow a student to pass the earlier grades easily, because they are not so technically important, and then, after perhaps three or four years, to stop his career and compel him to start life afresh, and handicapped by several years of age. If this is permitted, too, it serves as a constant temptation to the soft-hearted examiner (and, in spite of the probable personal experience of every one of us, examiners can be soft-hearted) to forget his duty to the public by passing through the ultimate gates of the profession men of whose scientific competency he has doubts. I know that all the pecuniary inducements of examining bodies, and the system of composition fees, are against the adoption of the course I urge, but on that account so much the more necessary does it appear to urge it.

Side by side with these changes in the aspects of scientific teaching has progressed that remarkable outburst of belief in the need of the higher scientific education and of faith in its efficacy, which has found expression in the establishment of a series of local colleges of lofty and far-reaching purpose, within the walls of one of which we hold this meeting; and upon these colleges the first of the changes to which I have referred, namely, the creation of a new conjoint field of study under the name of Biology, has had a remarkable effect. But fully to understand the nature of this it is necessary to point out that not merely did Professor Huxley believe in the unity of the subject, but, though probably not from belief, he practised the unity of the teaching; in other words, he himself conducted the whole of the teaching, botanical and zoological alike. The result of this is to be easily found in the nature of the teaching. Huxley is a zoologist. Rather less than one-third of the space, and very considerably less than one-third of the time, in this conjoint course is devoted to the botanical side of the subject, while of the types selected, though some are admirable, others are selected rather for their ease in acquisition than for their suitability as types, and the “jumps” are far too great. The other great biological teacher of the decade, Dr. Michael Foster, followed at Cambridge on much the same lines. Here, again, the teaching was done entirely by zoologists or zoo-physiologists,

and, most admirable though I can from my own experience attest it to have been both in matter and in method, it cannot be stated to have fairly included representatives of the vegetable kingdom. Now in Cambridge this did not act altogether disadvantageously, since Botany was there taught as a subject by itself by specialists of renown, who were able by their own force of character and inherent ability to hold their own. But what its effect would be in the country at large, and in the formation of the new local colleges, would not need the eye of a major prophet to determine.

Before 1870, two great metropolitan colleges, those of University and King's, and one provincial college, Owens at Manchester, were in existence, and at these the old distribution of the teaching power, modified by the improved nature of the teaching, naturally persisted. But what occurred in Birmingham, Bristol, Leeds, Liverpool, Newcastle, Nottingham, and Sheffield, where colleges of the university type one by one came into existence? In each of these, under the name either of Biology or of Natural History, a chair was founded, the primary teaching of which was to be "Biology," with, in the case of Nottingham, Geology thrown in. Of these seven professorships two were filled by geologists, the other five were occupied by zoologists. Thus Biology, instead of being a fair representative of the two sides of life, came, and from a natural sequence of events, to be looked upon as an appanage to Zoology. In some cases a demonstrator was appointed, and it is fair to assume, though this is difficult to verify, that he was in such cases appointed for his botanical qualifications. Now this could not fail to react upon the quality of the teaching; primarily, no doubt, causing the botanical side of Biology to be treated in the most perfunctory manner, for teachers are not all Huxleys and Fosters, and even they, as we have seen, were not free from this; and secondarily, by having their teaching energy frittered away in teaching subjects with which it is no injustice to them to say they were not familiarised, the interests of Zoology itself would come to suffer. Some colleges have not been slow to recognise this. Mason College, Birmingham, divided the chair into two of equivalent importance in less than two years after its opening; in 1886 Liverpool raised its demonstrator of Botany to the rank of a lecturer; while University College, Bristol, which, up to 1887, had had a professor of Zoology and a lecturer in Botany, in that year, as is stated in the calendar, "In consequence of the new regulations for the Intermediate Examinations in Science of the University of London, by which Botany is raised to

co-ordinate importance with Zoology, these two leading divisions of Biology will be treated separately by the lecturers in Botany and Zoology respectively," raised the lecturer in Botany to the rank of professor. The change which is here referred to, whereby the biological curriculum for the first scientific examination of the University of London was greatly enlarged upon its botanical side, was made in the year 1885, concurrently with the replacement of Botany by Biology in the first examinations for the medical degrees.

That the new local colleges have not made their mark in the biological portions of the examinations for London is clear, and mainly, I believe, this is due to the method of teaching adopted. To take a single illustration:—In the scientific examinations for the London Science degrees, up to and including last year, the whole of the above provincial colleges, including Owens College, Manchester, have secured ten honours in Botany, of which five have fallen to Mason College, two to Owens College, two to the Yorkshire College at Leeds, and one to University College, Liverpool; in Zoology the total number has been nineteen: fourteen to Owens, three to Mason College, and one each to Leeds and Liverpool. Thus more than half of the honours secured to the younger provincial colleges have fallen to the college in which the subject of Biology has been taught by two teachers of equal standing and approximately equal facilities; and the quality of the honours obtained but emphasises this statement.

But in the last two or three years two remarkable steps in a part reversion to the *status quo ante* 1875 have been made. One of these has been the withdrawal of Professors Huxley and Michael Foster, in London and Cambridge respectively, from the direct work of teaching "Biology," and in each of these cases, while the subject as such is retained, the teaching has been divided, the botanical and zoological portions being taken by a botanist and zoologist respectively. The second reversion is in its way no less remarkable. The ideal teaching of Biology commenced amongst those simple phases of life in which plant and animal find their common origin, and from that point, as in following up the two arms of a letter V, the two sides of life were followed up, diverging as they went, until in their culminating points they were so remote as to show no surface relationship together. This, too, is now altered, and instead the study is pursued, as philosophically it should be pursued, from the known to the unknown, from the highly developed to the simple. But this it is not difficult to see, alters the whole basis of biological teaching as heretofore understood.

Do not let it be imagined that I am in any way undervaluing the work which Huxley has done in this matter. Besides his inestimable labours in demonstrating to the public the perfect compatibility of "Science and Culture," labours with which the opening day of this Mason College will ever be associated, he has performed three great and peculiar services. He has taught us the unity of life in a way in which it had never been brought home to us before; he has shown us that for teaching, whether botanical or zoological, to be worthy of the name it must be carried out upon a philosophical basis; he has shaken up the dry bones of morphological Zoology and Botany and given a vividness and reality to teaching which it can never again lose. All teaching, whether of Botany or of Zoology, is now placed upon a biological basis more completely, perhaps, than Huxley himself had anticipated, and in England, at least, this is mainly due to his persistent efforts. If I rejoice in the part return to the *status quo* which I have already indicated, it is not from any want of the fullest sympathy with the pith and essence of Huxley's method, but rather from the profound belief that no effective living instruction can be imparted in even the elementary parts of a biological subject, excepting by one who has probed the subject to its inner depths, and that in these days the amplification of knowledge is so rapid that the men are few and far between to whom this is possible in more than one direction; in addition to which I cannot help thinking that the apparently inevitable annexation of chairs of Biology by those whose special bent is zoological, an annexation which is apparent in Wales, in Scotland, in Australia, and New Zealand, just as we have already seen it to be in England, would have been fatally destructive in its effects upon the higher study of my own subject.

There is work enough for the botanical teacher to do. As a science subject for schools, I believe botany to be unrivalled; but it will be incompletely taught if ideas are not implanted in the minds of the children as to the nature and purpose of what they observe, and as to the evident way in which nature and purpose inter-act; and the teachers themselves can only be trained in the lecture room and laboratory of a teaching university, or of some institution akin to Mason College, where a specialist is in charge of the subject. The scientific pursuit of agriculture, a thing well-nigh unknown a few years ago, and not too well known to-day, will depend in some degree at least upon a skilled botanical training, whether for the agricultural students themselves, or for those who are to teach them. For all who, in whatsoever walk in

life, have occasion to make use of the microscope, there exists no finer training ground than a study of the structure of plants. For the pharmaceutical chemist in that new departure which it is their early hope to make, a thorough grounding in botanical science will be a matter of necessity. But above and beyond all these practical and economic applications, there stands the grand educational principle that for those who follow knowledge, not as a means whereby to earn thirteen pence in the time in which a shilling had been earned before, but as a means for the full development of those faculties wherewith God has endowed them, there is no line of study which is profitless, no line of thought which is thrown away. The golden rule of our educational method of the future will, I believe, be not to accumulate information but to cultivate ability; not to cram the brain, but to train and develop the faculties. Knowledge may indeed be power, but intellectual power is more than knowledge.

ERRATUM.—On p. 85, l. 15 from foot, for “less” read “more.”

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Continued from page 90.)

V.—WHAT WOULD BE THE EXPENSE?

The matter of expense is not one that I can deal with from personal experience, but it will, nevertheless, be easy to show that the scheme that has been described would be much less expensive than the one recently adopted by the Northampton Town Council.

The particular advantages, in the matter of expense, are detailed below:—

1.—*There would be no reservoir to construct*, for the porous beds of the Marlstone would hold sufficient water for many years of drought.

2.—*There would be no pipes to lay*. A considerable item in most schemes of water supply is the purchase, and laying of pipes for the conveyance of water from the place where it is collected to where it is required;* but here the bed itself forms a sufficient means of communication from place to place.

* In the case of Northampton this is about seven miles.

3.—*No additional pumping station, or apparatus would be required*, at least for the present necessities of the town; for so long as the water levels were kept lower at Northampton than elsewhere, so long would the water chiefly flow to this place.

4.—*No artificial filter beds would be required*. With surface water, such as that obtained from running streams, or from impounding reservoirs, large filter beds have to be constructed and maintained in good condition; the initial expense is considerable, and there is a continuous one afterwards for cleaning. Of the three filters, through which it has been proposed to pass the water used in filling up the Marlstone, viz., the River gravel, Dumb-well, and Marlstone rock, only the well would necessitate expense in construction, and this would require little or no attention afterwards, for well clarified water only would reach it from the river gravel or drains.

5.—*The expense of constructing the dumb-wells* would then be the chief item. Within the area spoken of as suitable for the construction of such wells, none of them would exceed 140 feet in order to reach the lower water-bearing bed, and some of them would be less than this depth. From advice obtained, I do not think the wells themselves would cost more than £250 each, on an average. The highest figure that has been suggested by anybody for them is £1,000. I will accept this latter as the cost of them, not that I believe it possible they might cost this amount, but because it gives a good margin for certain contingencies or further developments, such as making drains to the wells in certain cases, making a communication with the river, or driving a heading to join the two water-bearing beds in case a well should be made on the wrong side of the Nen "fault," &c.

It might be advisable at the outset to carry a heading from the Billing Road well right up to the "fault," which could scarcely be more than 500 yards away, and then make it communicate with the higher water-bearing bed on the southern side of the "fault." Such a heading would aid very much the draining of the Marlstone, constitute in itself a considerable reservoir, and open up a communication with the southern Middle Lias area, which, so far, has yielded us no water. Of course, the supply from the southern area would not be large, because only the lower water-bearing bed comes into the town, but it would be a continuous and useful addition, and the amount would rather increase than diminish with use of the bed, as it has in the case of Messrs. Phipps and Co.'s well.

Naturally the question, whether it would not be better to put down a large number of small borings, instead of making these comparatively large wells, has suggested itself; it has, however, been dismissed on the ground of inefficiency and expense.

6.—*Total Expense.* A scheme which would enable the owners and occupiers of low-lying lands to get rid of much of the water which is now so troublesome ought to have the ready sanction and pecuniary aid of such persons, and, by mutual co-operation, a district greatly improved at comparatively small expense.

It might be that more than twelve wells would be advisable, and that considerable expense would be incurred in procuring the right to construct dumb-wells where most desirable, although they would occupy very little room. For these contingencies allow £13,000, making altogether £25,000, and then the whole scheme would be *one quarter of the expense* now being incurred for the construction of the Ravensthorpe Reservoir, &c., or a saving to the town of at least £75,000.

VI.—ARE THERE ANY SPECIAL NATURAL OR LEGAL DIFFICULTIES IN THE MATTER?

So far as I know, all the *natural difficulties* have been considered; nevertheless, a few observations on some natural and artificial processes, very nearly allied to those proposed, seem to appropriately come here.

I have very naturally been asked where such a plan has been tried. I am not aware that a new idea should not be tried because it has not been tried, and any denunciation founded on such a principle would be satisfactorily answered by saying that it has never failed. I grant that no such plan as this has been adopted, though the principle of swallow holes is well known, and has been recognised and advantageously utilised in numerous instances, as I propose to show.

At a conference on "Water Supply," held by the Society of Arts, at the Health Exhibition, July 24th, 1884, a paper was read by Mr. C. E. De Rance, A.I.C.E., F.G.S., &c. (the Secretary of the Underground Water Committee of the British Association), on "A Possible Increase of Underground Water Supply," in which was proposed, in general terms, the adoption of some such plan as the one under consideration, for all districts where permeable rocks were covered by impermeable. At this meeting the discussion was decidedly

favourable to some such scheme, and some of the observations elicited are recorded below:—

Mr. Conder, C.E., stated that the idea was good and feasible, and that the natural storage places for flood waters were the pervious water-bearing beds.

Mr. Baldwin Latham, C.E., pointed out that in India water was long ago stored in this manner.

General Hyde, of the Indian Railways Department, stated that in Peshawur, the natives have cut channels, in the rainy season, from time immemorial, so as to fill up a gravelly stratum, into which they make their wells through an overlying impervious deposit.

Sir Frederick Abel, C.B., F.R.S., the Chairman of the Conference, commented on the subject, and spoke of its great importance.

Mr. C. E. De Rance, A.I.C.E., F.G.S., has expressed the opinion* that the particular scheme set forth in these pages would succeed.

Until quite recently (January, 1888), I was not aware that anyone had proposed utilizing the river gravels for the storage of water, but I notice—

Professor Prestwich, F.R.S., has suggested† the use of the Thames gravel as a storage reservoir for flood water, whereby the winter water might be conserved, and used to increase the summer flow of the river, by damming back at a narrow part, and conducting it to a lower level down the river in time of drought.

SWALLOW HOLES.

To show that the estimations previously given as to the capacity of artificial swallow holes are not exaggerated, I propose to give now a few instances of the results obtained by some natural and artificial ones.

In Hertfordshire, a number of natural swallow holes bring the rainfall of an isolated clay basin of twenty-three square miles, lying outside the basin of the Lea, to feed the Amwell springs within the Lea basin, long since used by Sir Hugh Middleton to fill the New River.

Clay resting on chalk is sometimes drained by sinking dumb-wells and filling them with flints.

* Northampton Papers, October, 1884.

† “Rainfall and Evaporation,” by Symons, Greaves, and Evans. Excerpt Minutes of Proceedings of the Institution of Civil Engineers, 1876.

Mr. Bailey Denton, some years ago, secured the drainage of several hundred acres, on Lord Dillon's estate, in Oxfordshire, by bringing the water to a shaft, three feet in diameter, sunk for twenty to thirty feet in the Oolite, and disposed of the whole of the water.

Mr. W. H. Wheeler, *Mem. Inst. C. E.*, says* that in the Oolitic limestone districts, the waters from ditches may be frequently seen, when running a full stream from eighteen inches to two feet deep, to disappear from the surface, and be absorbed by swallow holes.

Professor Judd, *F.R.S.*, says† that "in the district embraced by sheet 64 of the one-inch Geological Survey Maps, 'Swallow Holes' are very common, the lines of junction of rocks, like the Upper Estuarine Clays and the Lincolnshire Oolite, are often marked by a series of these natural drains, a slight depression in the surface often indicating their position. In some cases the volume of water carried off by means of them is very great, and the roar produced by it in descending is heard at some distance. Smaller swallow holes may often be detected by placing the ear near the surface of the ground." Professor Judd further says:—"These swallow holes are well known to fox hunters, for the long sinuous fissures worn by the constant passage of water through the jointed limestone rocks constitute retreats for foxes, from which it is almost impossible to effect their dislodgment. Doubtless, also the caverns so frequently revealed in the midst of limestone rocks, during quarrying operations, owe their formation to the same agency. In effecting drainage operations, these natural means of carrying off the surface water are often imitated, and artificial swallow holes constructed, and they effect the removal of the *largest volumes* of surface water." Professor Judd gives two or three instances of a whole river disappearing into a porous bed, and re-appearing at the junction with the next impervious one, after flowing for a considerable distance, sometimes several miles: The River Witham, near Thistleton; the River Glen, between Little Bytham and Careby; and the brook which flows by the village of Benefield. Natural swallow holes will only be of common occurrence where the alternating

* "Arterial Drainage and the Storage of Water," by W. H. Wheeler, M.I.C.E., *Journal of Royal Agricultural Society*, vol. xxvii., part 1. 1878.

† "The Geology of Rutland, and the parts of Lincoln, Leicester, Northampton, Huntingdon, and Cambridge, included on sheet 64," by Jno. W. Judd, F.G.S. *Memoirs of Geological Survey*.

porous and impervious beds are comparatively thin, and, therefore, they are rare near Northampton, and west of it.

Of instances nearer Northampton than most of those given, I would point to the one at Welton clay pit, already referred to in Part I., where water passed into the Marlstone below, as fast as it could be delivered.

The Northampton sand is very much used as a receptacle for surplus water. Many drains in Northampton have no connection with the culvert, but gratings open on to the rock, and any quantity of water may be got rid of this way.

Limestone pits are sometimes drained by making a hole to the Northampton sand below. The limestone pit at Kingsthorpe was so drained a few years ago, my informant saying, that the water, which had given them so much trouble, was all disposed of in twenty minutes, after making communication with the porous bed below.

THE LEGAL DIFFICULTIES in connection with the carrying out of such a scheme as that proposed in these pages, I must confess, might be considerable, if any use were made of the river, or its feeding streams. The Nen is a remarkable instance of the divided control and jurisdiction which is often so detrimental to permanent improvements in a river course, for there are seventeen different bodies to deal with the riparian and the river interests.

When a stream is running over private ground, the stream is practically private property; it belongs to the riparian proprietor, and in cases where the stream divides two properties, the middle line of the stream is the boundary, but in neither case has the land owner the right to appropriate the water to the detriment of his neighbours. The Nen also is canalised eastward of Northampton, hence an additional difficulty is introduced. To my unlegal mind it does seem strange that opposition should be raised to a plan for relieving the river of surplus water, when it could be well spared, and might otherwise do damage. I do not believe the difficulties in this direction are insuperable; but, supposing they were, the scheme is only to a small extent injured thereby, for there is no similar jurisdiction over underground waters, such as would be chiefly used. An owner of certain lands can appropriate all the water flowing under them, whether it drains his neighbour's wells or not; hence the essential part of the scheme could be carried out by making arrangements with each land proprietor separately, a much easier matter than obtaining the united consent of a number of persons.

(To be continued.)

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, B.A., AND J. E. BAGNALL, A.L.S.

(Continued from page 133.)

Sub-genus II.—LEPIOTA.

10. **Ag. procerus**, *Scop.* Woods, pastures, etc. Aug.-Oct. Edgbaston Park! *With.*, 267. The Common, Kenilworth; Stoneleigh Park, *Russell*, *Illustr.* Bentley Park, 1869, *Bloxam*. Ansty, *Adams*. Pine wood, near Coleshill.
11. **Ag. rachodes**, *Vitt.* *Ag. procerus*, var. 3, *With.* Pastures. July-Oct. Edgbaston Park, *With.*, 267. Barrow Well Lane, Kenilworth, *Russell*, *Illustr.* Millfield, Ansty, *Adams*. Warwick Castle Grounds, *Perceval*. Sutton Park, borders of woods; Sutton; Kingswood.
12. **Ag. excoriatus**, *Schæff.* Pastures. July-Sept. *Ag. procerus*, var. 4., *With.* Edgbaston Park, *With.*, 268.
13. **Ag. gracilentus**, *Kromb.* Pastures. Sept. Kenilworth, *Russell*, *List.*
14. **Ag. acutesquamosus**, *Weinm.* Gardens and hothouses. Rare. Sept.-Oct. Garden at Kenilworth, *Russell*, *Illustr.* Sutton, on a cucumber bed.
15. **Ag. meleagris**, *Sow.* Greenhouses. Rare. Sept. In pots in greenhouses at Ansty Hall, *Adams*.
16. **Ag. clypeolarius**, *Bull.* Shady places. Rare. Oct. Edgbaston Park, *With.*, 270. In Oversley Lane, leading to the Mill, *Purt.* ii., 650. On the side of Ragley Park, near to Kingley, *Purt.* iii., 421.
17. **Ag. cristatus**, *Fries.* Fields and lawns. Aug.-Oct. Kenilworth, *Russell*, *List.* Ansty, *Adams*. Sutton Park; Driffold Lane, Sutton, on chips and sawdust. *Ag. clypeolarius*, var. 3, *With.*, 270, is probably this, as he mentions the "disagreeable smell."
18. **Ag. cepæstipes**, *Sow.* Hothouses. Rare. Hothouses, Ansty Hall, *Adams*. Sutton (var. *luteus*), in a forcing house, in great profusion.
19. **Ag. carcharias**, *Pers.* Pine woods. Rather rare. Sept.-Oct. Trickle Coppice, and New Park, Middleton; Water Orton; pine coppice, Coleshill Heath, abundant.
20. **Ag. granulosis**, *Batsch.* *Ag. croceus*, *Purt.* Woods, heaths, and footways. Sept.-Oct. Oversley, *Purt.* iii., 405. Bentley Park, 1849, *Bloxam*. The Common, Kenilworth, *Russell*, *Illustr.* Combe Ridings, *Adams*. Warwick, *Perceval*. Sutton Park; Trickle Coppice and New Park, Middleton; pine wood, Coleshill Heath; Coleshill Bog; Bradnock's Hayes; Hampton; Marston Green.

21. *Ag. amianthinus*, Scop. Woods. Rare. Oct. Birmingham Road, Kenilworth, 1871, *Russell, Illustr.*
22. *Ag. polystictus*, Berk. Amongst grass by road sides. Rare. Oct. Road sides, amongst grass, and on the Common, Kenilworth, *Russell, Illustr.*

Sub-genus III.—ARMILLARIA.

23. *Ag. melleus*, Vahl. *Ag. stipitis*, Sow., With. and Purt. *Ag. cumulatus*, With. On stumps of trees, hedge banks, and woods. Frequent. Aug.-Oct. Alne Hills, *Purt. ii.*, 532. Packington Park! *With.*, 189. Edgbaston! *With.*, 187-8. Crackley Wood! Birmingham Road, Kenilworth! *Russell, Illustr.* Ansty, *Adams*. School Close, *Rugby School Rep.* Warwick, *Perceval*. Sutton Park; New Park; Trickley Coppice; Middleton Heath; Coleshill Heath; Arley Wood; Marston Green; Castle Bromwich; Bradnock's Marsh; Solihull; Olton; Kingswood; Haywood; Waverley Wood, Stoneleigh; Oversley Wood; Ragley Wood.
24. *Ag. ramentaceus*, Bull. Woods. Rare. Oct. Spinney, near Ansty, *Adams*.

Sub-genus IV.—TRICHOLOMA.

25. *Ag. sejunctus*, Sow. Woods. Rare. Sept.-Oct. Burton Green Wood, near Kenilworth, *Russell, Illustr.*
26. *Ag. portentosus*, Fr. Wood. Sept.-Nov. Rare. Kenilworth, Nov., 1865, confirmed by Berkeley, *Russell, Illustr.*
27. *Ag. fucatus*, Fr. Pine woods. Rare. Crackley Wood! *Russell, Illustr.*
28. *Ag. spermaticus*, Fr. Woods. Rare. Sept.-Oct. Shawberry Wood, near Shustoke, 1882. Alveston Pastures, 1882. Confirmed by Dr. Cooke.
29. *Ag. nictitans*, Fr. Woods. Sept.-Oct. Local. Pool Hollies Wood, Sutton Park? pine wood, near Coleshill Pool; Plant's Wood; Tile Hill; agreeing with *Cooke's Illustr.*, t. 56.
30. *Ag. flavo-brunneus*, Fr. Woods and heaths. Rare. Oct. Windley Pool, Sutton; Coleshill Heath.
31. *Ag. albo-brunneus*, Pers. *Ag. viscosus*, Purt. Woods. Oct. Iron Cross, by the side of the turnpike road to Evesham, *Purt. iii.*, 208. Trickley Coppice, abundant.
32. *Ag. pessundatus*, Fr. Woods. Rare. Sept.-Oct. Among trees, the Spring, Kenilworth, *Russell, Illustr.*
33. *Ag. stans*, Fr. Woods. Rare. Oct. Edgbaston Park, amongst trees; agreeing with *Cooke's Illustr.*, t. 198. The two forms mentioned by Fries occurred together.

34. *Ag. rutilans*, Schæff. *Ag. xerampelinus*, With. Woods, amongst pine trees. Local. Oct. Red Rock Plantations, Edgbaston, 6th July, 1791, *With.*, 211. Hopsford, near Ansty, *Adams*. School Close, *Rugby School Rep.* Sutton Park; Coleshill Pool; Barton Green; Kingswood.
35. *Ag. luridus*, Schæff. Woods. Rare. Oct. Crackley Lane, *Russell, Illustr.*
36. *Ag. columbetta*, Fr. *Ag. leucocephalus*, With. Woods and pastures. Oct. Rare. Pasture land, Edgbaston, *With.*, 185. Burton Green Wood, *Russell, Illustr.* Combe Ridings, under firs, *Adams*. Coleshill Pool. Although Withering quotes Bull., t. 536, for his species, it is certainly not *Ag. albus*, Schæff, but agrees closely with the specimens from Coleshill Pool, which were very like *Cooke's illustr.* t. 48.
37. *Ag. sculpturatus*, Fr. Woods. Rare. Oct. Burton Green Wood, Oct., 1869, *Russell, Illustr.* High Over, near Combe, *Adams*.
38. *Ag. imbricatus*, Fr. Fir woods. Rare. Oct. Abbey Field, *Russell, Illustr.* Trickley Coppice, Oct., 1886.
39. *Ag. vaccinus*, Pers. Pine woods. Oct. Kenilworth, *Russell, List.* Combe Ridings, *Adams*. Sutton Park; Crackley Wood. Withering's plant, from Edgbaston Park (p. 196), is probably *Ag. imbricatus*.
40. *Ag. terreus*, Schæff. Woods. Rare. Aug.-Oct. Edgbaston Park, *With.*, 183. Plantations at Arrow in great plenty, *Purt.* ii., 630. Kenilworth, *Russell, List.* Waldegrave-on-Sow, *Adams*. Sutton Park. Var. *argyraceus*, Bull. Ansty, 1886, *Adams*.
41. *Ag. saponaceus*, Fr. Woods. Local. Sept.-Oct. Kingswood, *Hawkes!* Upper Holly Hurst, Sutton Park; Trickley Coppice; pine wood, Coleshill Heath; Alves-ton Pastures.
42. *Ag. cuneifolius*, Fr. Fields and near woods. Rare. Sept.-Oct. Abbey Fields, Kenilworth, *Russell, Illustr.* Sutton Park; New Park, Middleton.
43. *Ag. murinaceus*, Bull. Rare. Oct. Roadside bank, by Combe Park, *Adams*.
44. *Ag. virgatus*, Fr. Woods. Rare. Oct. Edgbaston Park; Coleshill Pool.
45. *Ag. sulphureus*, Bull. Woods. Sept.-Oct. Oversley Wood, *Purt.* ii., 628, Crackley Wood, *Russell, Illustr.* Combe Ridings, *Adams*.
46. *Ag. inamœnus*, Fr. Very rare. Sutton Park. Odour very unpleasant.

47. *Ag. gambosus*, *Fr.* Pastures. Rare. Warwick, *Perceval*.
Ansty, near Coventry, *Adams*.
48. *Ag. albus*, *Schæff.* Rare. Crackley Wood, Kenilworth,
Russell, Illustr.
49. *Ag. acerbus*, *Bull.* Woods. Rare. Oct. Crackley
Wood, *Russell, Illustr.*
52. *Ag. personatus*, *Fr.* *Ag. violaceus*, *With.* Woods.
Rare. Pastures, Edgbaston, *With.*, 204. Bentley
Park, *Bloxam*. Road sides, Brinklow Lane, *Adams*.
Roadside, near Wolvey.
53. *Ag. nudus*, *Bull.* Woods. Rare. Oct. Edgbaston,
With., 201. Kenilworth, *Russell, List.* Combe; Hops-
ford, *Adams*. Sutton Park.
54. *Ag. cinerascens*, *Bull.* Woods. Rare. Aug. Dale
House Lane, Kenilworth, *Russell, Illustr.*
55. *Ag. grammopodius*, *Bull.* *Ag. graveolens*, *With.* In
pastures. May-Oct. Red Rock Plantation, Edgbaston;
in rings under trees in the garden at Packington, *With.*,
178. In rings under trees in Ragley Park; at Pophills
and other places in the neighbourhood, *Purt. iii.*, 206.
Sutton Coldfield.
56. *Ag. brevipes*, *Bull.* On bare soil. Rare. Sutton Park
and Crystal Palace Grounds, Sutton.
57. *Ag. humilis*, *Fr.* Amongst grass. Aug.-Oct. Meadows,
Kenilworth, *Russell*. Edgbaston, *Robinson!* Sutton.
58. *Ag. pædidus*, *Fr.* In fields. Sept.-Oct. Fields near
Maxtoke Priory, abundant.

(To be continued.)

CONCHOLOGICAL NOTES FROM SOUTH BEDS.

The prevailing subsoil of South Beds being calcareous, it is not surprising that the shell bearing mollusca are numerically abundant in the district. It is also probably rich in specific forms, which is rather suggested than proved by the following list, which is almost entirely the result of two seasons' work by my son Edgar, who at present is quite a juvenile. The nomenclature may be accepted with confidence, as specimens of every variety have been forwarded to Mr. Taylor, of Leeds, to whom we are deeply indebted for his assistance in naming.

CLASS I. CONCHIFERA.

FAMILY SPHÆRIDÆ.

Sphærium corneum, River Lee, in Luton Hoo Park; Ponds at Limbury.
var. *nucleus*, Limbury.

lacustre, Limbury. Near Dunstable. R. Rogers.

Pisidium pusillum, Pond at Hitchin End, amongst *Hypnum aduncum*.

FAMILY UNIONIDÆ.

Anodonta cygnea, abundant in the River Lee, South of Luton.

CLASS II. GASTEROPODA.

ORDER I. PECTINIBRANCHIATA.

FAMILY PALUDINIDÆ.

Bithynia tentacula, Limbury.

ORDER II. PULMONOBRANCHIATA.

FAMILY LIMNÆIDÆ.

Planorbis albus, Pools at Limbury and Harlington.

vortex, Pools at Limbury.

curneus, Pools and Streams, Limbury, Biscot, and Luton Hoo Park.

contortus, Pools, Limbury.

complanatus, Pools, Limbury.

nitidus, „ „

marginatus, „ „

nautilus, Pools, Limbury; Hitchin End, with *Pisidium pusillum*.

Physa fontinalis, Luton Hoo Lake.

fluviatilis, sources of the River Lea, Leagrave.

Limnea peregra, Limbury, Biscot, Luton Hoo Lake. Near Dunstable.

R. Rogers.

var. *ampullacea*, Luton Hoo Lake.

var. *oblonga*, Limbury.

auricularia, Luton Hoo Lake, very fine.

var. *minor*, with the type, Luton Hoo Lake.

stagnalis, common.

var. *turgida*, Limbury.

palustris, Limbury.

Ancylus lacustris, Reed Pond, Sundon, Limbury.

TERRESTRIAL.

FAMILY LIMACIDÆ.

Arion ater, Luton.

flavus, „

hortensis, Luton.

var. *subfusca*, Luton.

Bourguignati, General Cemetery, Luton.

Limax agrestis, Luton.

var. *sylvatica*, near Luton.

maximus,

var. *fasciata*, Luton.

FAMILY HELICIDÆ.

Succinea putris, Limbury Marsh, Flitwick Marsh.

Vitrina pellucida, Luton, Limbury.

Zonites cellarius, near Luton, Someries Castle.

nitidulus, Garden, Luton.

crystallinus, Limbury.

Helix aspersa, common.

nemoralis, common.

var. *castanea*, 00000

var. *libell.*, 00000

var. „, 00300

var. *rubella*, 00300

var. *carnea*, 00300

} Luton.

hortensis.

var. *carnea*, 00000 } Luton.

var. *lutea*, 123 45 } Dunstable Downs. R. Rogers.

arbustorum, Luton. Dunstable Downs. R. Rogers.

var. *alpestris*, Totternhoe Mead.

rufescens, Luton. Dunstable Downs. R. Rogers.

var. *rubens*, Luton.

Helix hispida, Limbury, Luton.

sericea, Limbury.

- *cantiana*, Luton. Dunstable Downs. R. Rogers.

virgata, Warden Hills. Dunstable Downs. R. Rogers.

caperata, Warden Hills.

var. *fulva*, Chalk Pit, near Luton.

ericetorum, on the Chalk Hills. Dunstable Downs. R. Rogers.

rotundata, near Luton. In the General Cemetery quite a colony was found in an old boot.

pulchella, Harlington. Biscot.

lapicida, Limbury.

Bulimus obscurus, near Luton.

Pupa marginata, Warden Hills.

Vertigo pygmaea, „

Clausilia rugosa, Limbury, Chorlton, Luton, &c. A dead shell, with two mouths, was found at Limbury.

laminata, Luton, Limbury.

Cochlicopa lubrica, Limbury.

Achatina acicula, Dunstable Downs.

FAMILY CARYCHIIDÆ.

Carychium minimum, Limbury, by the Catsbrook.

FAMILY CLYCLOSTOMATIDÆ.

Cyclostoma elegans, common on the Chalk Hills.

J SAUNDERS, LUTON.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

WEDNESDAY AND THURSDAY, JULY 4TH AND 5TH.

The following is the programme of proceedings for the forthcoming Meeting of the Union at Northampton:—

WEDNESDAY, JULY 4TH.

COUNCIL.—The Council will assemble at 11.30 a.m., in the Old Museum Room, at the Town Hall, Northampton.

ANNUAL MEETING will be held at 2.30 p.m., in the Old Museum Room, at the Town Hall; the President of the Union (The Right Hon. Earl Spencer) in the chair.

An address will be delivered by the Rev. H. H. Slater, F.Z.S., Vicar of Irchester, Northamptonshire, and member of the British Ornithological Union.

The further business of the Meeting will be to receive the report of the Council and the Treasurer's accounts, to fix the place of the next Annual Meeting, to consider any suggestions that members may offer, to discuss the work of the Union during the coming year, and to transact all necessary business.

Opportunities will be afforded for visiting some of the chief places of interest in the town, including some of the principal manufactories.

The Rev. T. C. Beasley, hon. sec. of the Northampton Architectural Society, has kindly consented to conduct a party to view the most interesting of the Churches of Northampton, leaving the Town Hall at 4 p.m., after the Annual Meeting.

RECEPTION ROOM.—A Reception Room will be provided at the Peacock Hotel, Market Square, for the convenience of visitors, and letters may be addressed there. Visitors are requested to enter their names and temporary addresses in the arrival book, which will be on the table. The room will be supplied with newspapers.

LUNCHEON.—A Luncheon will be provided at the Peacock Hotel, at 1.30 p.m., for the Council, members of the Union, and visitors. Tickets, 2s. 6d. each; early application for which is requested.

THE CONVERSAZIONE will be held in the Town Hall, on Wednesday evening, at 7.30.

The Northamptonshire Natural History Society has arranged for exhibitions of objects of scientific interest by its various sections, and by the members of other Societies in the Union. There will be a number of microscopes and other scientific instruments. The Society will be much obliged for the loan of microscopes, instruments, or objects from the members of the Union.

In connection with the Geological Excursion on the following day (Thursday), B. Thompson, Esq., F.G.S., will read a short paper on "The Jurensis Zone in Northamptonshire."

The Conversazione has been arranged in connection with the Annual Meeting of the Northampton Architectural Society, and short papers will be read by members of that Society during the evening.

Arrangements have been made for selections of instrumental music to be given during the evening. Tickets, 2s. each. *Evening dress optional.*

THURSDAY, JULY 5TH.

EXCURSIONS.

1.—ARCHÆOLOGICAL EXCURSION.—Members of the Union and friends will be permitted to join the Annual Excursion of the Northampton Architectural Society, under the leadership of Sir Henry Dryden. The party will leave the Castle

Station at 9.20, and proceed by train to Higham Ferrers. Here they will be met by a coach, and drive to Higham Ferrers Church, Rushden, Irchester, and Castle Ashby, where they will lunch, and visit the Castle and grounds. They will then drive to Whiston and Earl's Barton, inspecting the fine Saxon Tower of the Church there, and reach Northampton about 6 p.m. Those who prefer can take the train at Castle Ashby at 3.39, reaching Northampton at 3.59. *Applications for this excursion must be made before June 25th.*

2.—BOTANICAL EXCURSION.—The train will be taken to Daventry, whence the party will drive to Fawsley. By kind permission of Sir Rainald Knightley, there will be an opportunity of exploring Badby Woods, one of the best botanical localities in the county, and of visiting the Dower House, and other objects of interest in Fawsley Park. Lunch will be provided on returning to Daventry.

3.—GEOLOGICAL EXCURSION.—After visiting some of the more important pits in the neighbourhood of Northampton, the Limestone Works at Moulton Park will be inspected, and the party will proceed by Brampton to Harlestone, where they will lunch. It is hoped that Althorp House may then be visited, and on the return journey various sections of the Inferior and Great Oolites will be seen.

Tickets for either excursion will be 8s. 6d. (including luncheon).

Early application should be made for tickets, the possibility of carrying out the excursions depending greatly on the number of applicants.

All applications to be addressed to H. N. Dixon, Esq., Wickham House, East Park, Northampton.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 124.)

EDWIN LEES, IN HIST. ILL. NAT. HIST. WORC.

* *Dianthus Armeria*, 163. In a meadow beyond Mudwall Mill, and about Cotheridge. Also at Shrawley, near the church, and in a meadow near Kempsey. S.G. L.M.

* *Saponaria officinalis*, 163. By the side of the pool in Shrawley Wood. Also near Bewdley and Bromsgrove Lickey. S.G. L.M.

Silene noctiflora, 163. In a sandy field behind Birchen Grove, Broad Heath.

- * *Mœnchia erecta*, 153. Rocks on the North Hill, Malvern.
- * *Stellaria uliginosa*, 163. In various marshy spots about Hartlebury Common, Malvern Hills, Ashmore Common, &c. L.M.
- Arenaria trinervis*, 163. Shady lanes about Worcester. Ankerdine Hill.
- * *A. tenuifolia*, 163. Lane near the Toot Hill, behind the Virgin's Tavern, Worcester. *A doubtful record. Not acknowledged in the Severn district in Mr. Lees's "Botany of Worcestershire."*
- * *A. rubra*, 163. A pretty ornament of the dry declivities of the Malvern Hills. L.M.
- * *Spergula nodosa*, 164. In the rill that rises in the declivity between the Worcestershire Beacon and the Sugar Loaf Hill, Malvern. *This is the plant called by Mr. Lees "Spergula saginoides" in Loudon's Magazine.*
- Scleranthus annuus*, 163. On the rocks of the Malvern Hills.
- * *Montia fontana*, 152. Plashy rills on the Malvern Hills, and on the Common called the Link. S.G. L.M.
- * *Hypericum Androsæmum*, 173. In a hedge at the western base of the Worcestershire Beacon, Great Malvern. Mr. James Goodman. On Abberley Hill, growing among the underwood to a great size. Messrs. Walcot, Lees, and Edmunds. Also on Bredon Hill, above Elmley Castle. L.M.
- H. calycinum*, 173. In a copse at Little Malvern, but doubtful if truly wild. Mr. Lees.
- H. quadrangulum*, 173. Lane at Kempsey, and many marshy spots in the county.
- * *H. humifusum*, 173. On the North Hill, Malvern. Dr. Streeten. Also near Nunnery Wood and on Helbury Hill.
- * *H. hirsutum*, 173. Woody places about Worcester, not unfrequent.
- * *H. montanum*, 173. Shrawley Wood and Abberley Hill.
- * *Malva moschata*, 171. At Henwick Hill, Helbury Hill, and various other places, chiefly by the road side.
- * *M. rotundifolia*, 171. Not frequent in this county. At the base of the North Hill, Malvern. About Kempsey.
- * *Tilia parvifolia*, 166. Glens and lanes about the Old Storage Hill, and at Clifton-on-Teme. L.M.
- †* *Linum usitatissimum*, 159. In Cowleigh Park, to the north of Malvern. *Cowleigh Park is in Hereford.* L.M.
- * *Geranium sylvaticum*, 170. In Bewdley Forest, near to Dowles Brook, plentifully. Messrs. Walcot and Lees.
- * *G. pratense*, 170. Strikingly conspicuous with its large azure flowers, and a great ornament to the banks of the Severn and many of our minor brooks.
- * *G. columbinum*, 170. By the side of the shady walk beyond the Old Waterworks, and in several lanes about Worcester and Hallow. On Abberley Hill.
- * *G. lucidum*, 170. By the side of the moors, Worcester, and along the lane at Merryman's Hill. At Malvern, Abberley, &c. S.G. L.M.

- Erodium cicutarium*, 170. By the side of the road near Hallow, abundantly, and in the road leading to Mr. Farley's, Henwick Hill. Pasture at Kempsey.
- * *E. maritimum*, 170. Growing in considerable plenty on the rocks fronting the south-west at the Giant's Grave, Habberley, 1834. Mr. Lees.
- * *Euonymus europæus*, 156. In a hedge near the end of the avenue at Dr. Berkeley's, Cotheridge Court. Also near Malvern.
- * *Rhamnus catharticus*, 156. In the hedges about Worcester, formerly common. In the coppice near Battenhall.
- * *R. Frangula*, 156. In Wyre Forest.
- * *Anthyllis vulneraria*, 171. Abundant on the limestone on the western flanks of the Malvern Range, and equally plentiful on the lias at Craycombe Hill. L.M.
- † * *Trifolium ochroleucum*, 173. On the Link, at Malvern. *An error.*
- * *T. arvense*, 173. At Malvern, Powick, and on Hartlebury Common.
- * *T. fragiferum*, 173. On the Spetchley Road before the late enclosures. Evesham, on the Stratford Road. Avon Meadows, Pershore.
- Lotus major*, 173. In the Gullet, a woody glen of the Malvern Range, and at the base of Abberley Hill. Tiddesley Wood, near Pershore.
- * *Astragalus glycyphyllos*, 172. Helbury Hill, Worcester; the Trench Woods, &c.
- * *A. hypoglottis*, 172. Bredon Hill, near the Camp. Nash. Still there about two fields southwards of the outer vallum. Mr. Lees.
- * *Ornithopus perpusillus*, 172. On the Malvern Hills, Hartlebury Common, Kempsey Common, and Blakebrook, near Kidderminster. L.M.
- * *Hedysarum Onobrychis* (*Onobrychis sativa*), 172. Abundant on the Abberley Hills. Also on the limestone west of the Malvern Chain, and on the lias at Craycombe. L.M.
- * *Vicia sylvatica*, 172. In the Devil's Den, Clifton-on-Teme, and in a wood near the Spout, Malvern. In the greatest luxuriance at Lower Sapey. Dr. Field, and Messrs. Allies and Lees, 1834. S.G. L.M.
- * *V. angustifolia*, 172. Near the Giant's Grave, Habberley. Ankerdine Hill.
- V. lathyroides*, 172. Battenhall Lane, Craycombe Hill, and numerous other places in the county.
- * *V. bithynica*, 172. Below the Ivyscar Rock, Great Malvern. Mr. Lees.
- * *Lathyrus Aphaca*, 171. Near Crowle. Mr. Sheppard, 1834.
- * *L. Nissolia*, 171. Among the bushes beyond Battenhall Lane, Worcester, and by the wood near the Croft Farm, Mathon. Mr. Lees. Also in a meadow at Kempsey. Dr. Streeten. S.G.
- * *L. sylvestris*, 171. Perry Wood, and Helbury Hill, on the east side of Worcester; in the woods about Bredon Hill; and Tiddesley Wood, near Pershore. S.G.

-
- * *Prunus insititia*, 164. Dudley Castle Hill. S.G.
 - P. domestica*, 164. In the hedges near Battenhall, but doubtful if wild.
 - * *P. Cerasus*, 164. Wild cherry tree. (*Must be P. Avium, L.*) On Rosebury Rock, Knightwick, and Ankerdine Hill. A solitary tree appearing on Helbury Hill, near Worcester, when the wood was cut down. S.G.
 - * *Spiræa Filipendula*, 165. At the west end of Perry Wood, and on the Old Hills, but rather rare. Hedges at Brookend, near Kempsey. S.G.
 - * *Agrimonia Eupatoria*, 164. Frequent by road sides in various places.
 - * *Sanguisorba officinalis*, 153. Very rare. In moist ground at the south-west side of Nunnery Wood. S.G. *Not uncommon in the north of the county. "Fairly common between Madresfield and the Rhydd."* Mr. Towndrow.
 - Alchemilla arvensis*, 153. Lanes about Henwick, and Malvern Hills.
 - * *A. vulgaris*, 153. Lane leading to Henwick Mill. Also in fields at Grimley and Alfrick. L.M.
 - † *Tormentilla reptans*, 166. Near Cowleigh Park, north of Malvern. *Probably a Hereford record.*
 - * *Potentilla argentea*, 166. On the sand rock between Bromsgrove and Droitwich. On a similar rock near Holt, &c. L.M.
 - †* *P. verna*, 166. On the rocks of the Herefordshire Beacon, Malvern. Mr. Lees. L.M. *A Hereford record.*
 - * *Comarum palustre*, 166. On Hartlebury Common, and in pools about Bromsgrove Lickey.

(To be continued.)

REMARKS AS FOOTNOTES TO "THE CLIMATE OF BRISBANE."

The highest percentage of relative humidity, viz., 100, or absolute saturation, usually occurs in the early morning before sunrise, and the lowest percentage in the afternoon.

The most striking meteorological event during the year was the heavy rainfall of January 21st, 18·305 inches, or 1,848½ tons per acre falling within 24 hours. This fall occurred during the passage of cyclonic disturbance from the neighbourhood of New Caledonia; and the disastrous floods resulting in the south-eastern portion of the colony form a prominent feature in the history of Queensland.

Much valuable information relating to the distribution of pressure over Eastern Australia may be gathered from the

NOTES ON THE CLIMATE OF SOUTH QUEENSLAND.

THE CLIMATE OF BRISBANE* DURING THE YEAR 1887.

BY CLEMENT L. WRAGGE, F.R.G.S., F.R. MET. SOC., ETC.,

GOVERNMENT METEOROLOGIST FOR QUEENSLAND (LATE OF BEN NEVIS OBSERVATORY).

| Month. | PRESSURE. | | | SHADE TEMPERATURE. | | | | | | | HYGROMETRIC CONDITIONS. | | | | | WIND. | | CLOUD. | RAINFALL. | |
|---|---|---------------------------------------|--------------------------------------|-----------------------------|-------------------------------------|-----------------------------------|-----------------------------------|-------------------|-----------|-----------|-------------------------|--|-----------------|-------------------|------------------|--------------------------------|-------------|-----------------------------|--------------------|---------------------------------------|
| | Mean pressure. Barometer at 32° Far. | Highest reading of barometer. + | Lowest reading of barometer. + | Mean temperature of air. | Mean temperature of evaporation. | Max. shade temperature of air. | Min. shade temperature of air. | Mean daily range. | Mean max. | Mean min. | Mean vapour tension. | Mean humidity. (Saturation equals 100.) | Mean dew point. | Highest humidity. | Lowest humidity. | Velocity in miles per hour. | Prevailing. | Amount. (Scale 0 to 10.) | No. of rainy days. | Total for month. |
| January..... | 29·854 | 30·040 | 29·560 | 76·6 | 70·8 | 92·5 | 64·2 | 15·0 | 85·1 | 70·1 | ·656 | 72 | 66·7 | 100 | 30 | 12 | E. | 5·8 | 17 | 23·334 |
| February | 29·874 | 30·184 | 29·321 | 74·2 | 69·6 | 92·6 | 62·3 | 13·3 | 81·7 | 68·4 | ·645 | 76 | 66·3 | 100 | 47 | 11 | S.E. | 7·2 | 25 | 6·403 |
| March..... | 30·000 | 30·264 | 29·783 | 74·3 | 70·7 | 88·4 | 63·5 | 12·6 | 81·7 | 69·1 | ·689 | 81 | 68·1 | 100 | 46 | 11 | S.E. | 7·0 | 30 | 12·088 |
| April | 30·107 | 30·277 | 29·910 | 67·2 | 64·6 | 84·1 | 55·1 | 14·5 | 77·3 | 62·8 | ·568 | 85 | 62·5 | 100 | 50 | 11 | S. | 5·0 | 28 | 3·341 |
| May | 30·098 | 30·282 | 29·825 | 61·0 | 55·9 | 79·4 | 44·5 | 18·0 | 70·9 | 52·9 | ·381 | 72 | 51·5 | 100 | 35 | 9 | S. | 4·3 | 13 | 3·046 |
| June | 30·010 | 30·429 | 29·738 | 56·3 | 50·1 | 75·0 | 41·9 | 17·3 | 65·7 | 48·4 | ·293 | 65 | 44·4 | 100 | 38 | 9½ | W. | 3·7 | 5 | 0·168 |
| July | 30·118 | 30·391 | 29·807 | 57·5 | 52·4 | 77·0 | 40·4 | 18·9 | 67·7 | 48·8 | ·332 | 70 | 47·8 | 100 | 35 | 7½ | W. | 4·1 | 8 | 7·507 |
| August | 30·198 | 30·445 | 29·925 | 59·3 | 55·0 | 76·5 | 37·4 | 18·4 | 69·5 | 51·1 | ·377 | 74 | 51·2 | 100 | 32 | 7½ | S. | 5·2 | 19 | 11·796 |
| September ... | 30·034 | 30·248 | 29·657 | 63·2 | 56·4 | 80·7 | 44·5 | 19·9 | 73·6 | 53·7 | ·369 | 64 | 50·7 | 100 | 25 | 10 | W. | 3·5 | 17 | 1·921 |
| October | 30·038 | 30·356 | 29·684 | 68·5 | 61·5 | 90·6 | 50·6 | 21·3 | 79·9 | 58·6 | ·450 | 64 | 56·0 | 100 | 12 | 12½ | N. | 4·1 | 22 | 4·824 |
| November ... | 30·030 | 30·267 | 29·662 | 69·7 | 63·3 | 90·7 | 54·9 | 18·8 | 79·9 | 61·1 | ·488 | 68 | 58·3 | 100 | 10 | 14 | N. | 5·8 | 29 | 2·970 |
| December..... | 30·072 | 30·264 | 29·721 | 72·3 | 65·8 | 88·0 | 59·5 | 16·0 | 80·9 | 64·9 | ·536 | 68 | 60·9 | 100 | 27 | 14 | E. | 6·2 | 25 | 4·138 |
| Grand means for year, with total rainfall | 30·036 | | | 66·7 | 61·3 | | | 17·0 | 76·2 | 59·2 | ·466 | 71 | 56·9 | | | 10½ | | 5·2 | | 81·536 Total rainfall for year. |

* As the reorganisation of the Queensland Meteorological Observing-System could not be commenced until January 1st, 1887, it is obvious that complete climatological records for the year 1887 for other stations than Brisbane cannot be given.
+ Corrected and reduced from self-recording instruments.

prevailing winds at Brisbane alone. For instance, the easterly currents of December and January prove that seasonal low pressure exists over North Queensland, and that prevailing anticyclonic or high-pressure systems cover New South Wales, and overlap its coast-line.

The south-east currents of February and March show that anticyclonic nuclei, or "mounds" of high pressure, are then of frequent occurrence over the Riverina country, and that their north-eastern slopes over-reach the Queensland border and the Pacific coast.

The southerly winds of April and May distinctly show the progress of the earth's revolution and its effect on the pressures. The sun's northern declination is increasing, hence the land of Australia is chilling and the air becoming denser. This tends to draw the high-pressure centres nearer the Tropic of Capricorn.

The westerly winds of June, July, and September are intensely dry and chilling, but distinctly purifying and bracing. They prove that the anticyclone or high-pressure system, which is a seasonal feature of the interior at this time, has its nucleus near Alice Springs, and that its slopes extend well over Northern Queensland, while low pressure or cyclonic systems cover the ocean between New South Wales and New Zealand.

The southerly currents of August indicate a temporary "backing" to southward of the anticyclone of Central Australia, and a low barometer at Norfolk Island.

The northerly winds of October and November indicate in a most striking manner the effect of the sun's increasing southern declination. The atmosphere over the continent is becoming heated and more rarefied. The central high pressures have collapsed, and areas of low barometer are taking their place, while anticyclonic types are forming on the ocean side of the Barrier Reef.

In accordance with the rules of the Royal Meteorological Society, values of 0·006 and over are taken as rainy days. During September, October, November, and December, however, heavy dews frequently gave 0·006. Virtually the actual number of rainy days for those months was as follows:—viz., 8, 11, 20, and about 15 respectively.

From an intelligent perusal of the figures in the synopsis of the Brisbane weather, it is evident that the South-east portion of Queensland possesses a decidedly genial climate. Although December, January, and February are virtually tropical months, a new arrival from the Old Country may enjoy the best of health by partaking freely of those luscious

fruits, such as bananas, pineapples, and melons, which are produced in lavish abundance; by abstaining from the use of animal food in such quantities as was his wont in northern climes, and by abjuring all excess in alcoholic stimulants. The climate during the remainder of the year is delightful, although the westerly winds of winter may be rather too bracing for those who have long suffered from serious chest affections. And, again, our observations so far show that the climate of those vast inland regions, such as the Darling Downs, Maranoa, and Warrego districts, is distinctly salubrious and much drier than that of the ocean slope. In fact, during those months that are virtually tropical on the Pacific coast, where the humidity is relatively high, the difference between the dry and wet bulb thermometers at such places as Roma and Thargomindah may exceed 37 degrees, giving a percentage of humidity as low as 4, saturation equalling 100. Heavy ground frosts occur on the Downs and Border Tableland during May, June, and July, and ice is of frequent occurrence there during that period.

That there is a variety of climate within South Queensland suitable for every type of those invalids, to whose restoration to health climatological conditions are the most important factor, is my firm conviction; and when we consider the abundant rainfall of Eastern South Queensland (despite periods of drought) as compared with that of some places in the Southern Australian Colonies, and the magnificent agricultural, pastoral, and mineral resources of the Southern portion of the colony as a whole, it is evident that Brisbane, as the capital city and principal outlet of produce, must increase, and that it has before it a future that will prove unique in the annals of prosperity, and in the history of the great British Empire. I believe that the underground water reservoirs in the far West are most ample. I reserve notes on the climate of North Queensland until more data are forthcoming, although from what is already known of its tropical climate and magnificent natural wealth, it is difficult to foresee a future any less brilliant than that we most conscientiously predict for the Southern portion of the colony.—CLEMENT L. WRAGGE, *Government Meteorologist of Queensland*.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—MICROSCOPICAL SECTION.—May 3rd. The first meeting of the section this year was made special by a large number of microscopes being exhibited, and the members were successful in affording

a very interesting and instructive evening. After a few introductory remarks from the president, Mr. W. B. Grove, B.A., Mr. W. P. Marshall read a paper from Mr. E. W. Burgess, giving an account of the Foraminifera dredged by this Society during the Oban Excursion, in 1883, and a fine slide of sixty-seven named and mounted specimens, prepared by him from that material, was presented to the Society. Amongst the objects exhibited were the following:—Mr. W. B. Grove, B.A., *Bovista nigrescens* and *Badhamia hyalina*, from neighbourhood of Shustoke; *Peronospora alsinearum*, Casp. (new to Britain), from Fillongley; *Peziza leucomelas*, Pers. (new to Britain), from Clevedon; also, for Mr. Walliker, a piece of the so-called Lydian stone, used as a touchstone to distinguish pure from base metal; and a portion of a stone ornament, blown up and thrown into the instrument room at the Telegraph Office, Cannon Street, during the fire at Messrs. Marris and Norton's. Mr. T. H. Waller, B.Sc., granules and crystals of zircon and rutile, from Oldbury. Mr. W. P. Marshall, M.I.C.E., tadpole of frog, showing the circulation in the external gills, &c. Mr. J. Edmonds, *Trypeta reticulata*. Mr. F. Derry, crystals of brucine. Mr. J. Udall, circulation in gills and tail of tadpole. Mr. T. E. Bolton, *Ædogonium*, showing fructification; *Closterium rostratum*, with zygosporcs; and *Lophopus crystallinus*. Mr. W. H. Wilkinson, specimens of lichens from Mount Stewart, Isle of Bute, gathered during the visit of the Cryptogamic Society of Scotland; a collection of lichens from near Crieff; and from Dr. J. Stirton, the following rare and interesting lichens, *Cladonia lacunosa*, from Newfoundland; *C. retipora* and *C. aggregata*, from New Zealand; *C. cariosa*, from Norway; and *Myriangium Duriaci*, from Cornwall.—On Whit Monday, a party of about fifty members of this Society made an excursion to Dovedale. On reaching Derby they drove *via* Ashbourne to the foot of Thorpe Cloud, and after luncheon the party proceeded to the Dale, under the guidance of the Rector of Alstonefield. Some of the more uncommon plants seen were *Saxifraga granulata*, which was abundant everywhere; *S. hypnoides*, on the slopes of Thorpe Cloud; *Arabis hirsuta*, on rocks in the stream; while *Myosotis collina*, *Veronica arvensis*, *Saxifraga tridactylites*, geranium, and the pretty little draba formed a many-coloured patch on every boss of rock where the soil was thinnest. The rare moss *Neckera crispa* was also gathered, and the place was pointed out where *Hypnum rugosum*, the "Dovedale moss," was formerly so abundant, though now scarcely a fragment can be found. This latter species never fruits in England now, and it was suggested that this may be the cause why it was unable to maintain its ground. On the return journey, Derby was reached at 8.45. A short visit was here paid by some of the party to the Free Library, to seek for a memorial of Mr. Herbert Spencer, who was born in a little house, No. 8, Wilnot Street, Derby. SOCIOLOGICAL SECTION.—April 24th. Mr. W. R. Hughes, F.L.S., in the chair. A vote, congratulating Mr. Herbert Spencer on attaining his sixty-eighth birthday, was passed; and the secretary was requested to forward the same to him. A vote of condolence with the family of the late Mr. Matthew Arnold was also passed. A paper was read by the hon. secretary, Mr. F. J. Cullis, upon Prof. Fiske's "Cosmic Philosophy." Supplementary Meeting, held Thursday, May 3rd. Mr. W. R. Hughes, F.L.S., in the chair. A letter from Mr. Herbert Spencer was read, replying to the vote of congratulation passed at the previous meeting. An exposition was given by Mr. Stone on the fifth chapter of Mr. Herbert Spencer's "First Principles," entitled "The Reconciliation." An animated discussion followed. Supplementary Meeting, held May 17th. Mr. W. R. Hughes, F.L.S., in the chair.

Mrs. A. Browett gave an exposition of the first chapter of the second part of Mr. Herbert Spencer's "First Principles," entitled "Philosophy Defined." A discussion followed.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—April 23rd. The Chairman presented to Mr. C. Beale, C.E., on the occasion of his leaving England, a handsomely bound copy of Longfellow's Poems, with an illuminated address on the title page, as a testimonial of the esteem in which he was held, and in recognition of his many kindnesses to the Society. Mr. Beale having suitably replied, the following exhibits were made:—Mr. Evans, *Trigonia gibbosa* in Portland stone, also specimen of rhyolite from the Wrekin; Mr. W. H. Bath, collections of marine algæ from Weymouth and Bournemouth. Under the microscope, Mr. Collins showed a section of stem of dog rose through a spine; Mr. Hawkes, tetraspores of *Callothamium roseum* and *Dasya coccinea*.—April 30th. Mr. W. H. Bath presented a copy of his book, "The Young Collector's Handbook of British Birds: their Nests and Eggs." Mr. J. Madison exhibited specimens of *Helix pisana*, from Guernsey; Mr. J. Betteridge, specimen of dunlin, *Tringa alpina*, in full summer plumage, shot near Westheath; also a specimen of common tern, *Sterna fluvialis*, from Harborne. Mr. J. A. Green then read a paper on "The Polarization of Light." The writer said the term polarization was a description of any cause which produced two opposite or antagonistic states. It would be necessary to take into consideration the normal condition of light before we could understand the changes that took place. Light was compound in its nature, and was seen analysed in the solar spectrum. The structure of the Nicol's prism was described, and how it divided the two rays, reflecting one and refracting the other, and the arrangements for adapting them to the microscope were shown. The paper concluded by referring to the use of polarized light in the study of mineralogy, chemistry, and other sciences.—May 7th. Mr. Deakin exhibited specimens of butterflies, from British Burmah; Mr. J. Madison, specimens of *Helix cartusiana*, *Clausilia itala*, *Pupa frumentum*, and other shells, from Italy; Mr. Barradale, cotton pods, from Ceylon and China; Mr. J. W. Neville, a series of objects illustrating the development of *Nepa cinerea* from the egg to the imago.—May 14th. A lecture was delivered by Mr. T. H. Waller, B.A., B.Sc., on the "Micro-Chemical Examination of Minerals." The speaker said that when you examined a thin section of rock, owing to the crystals being seen in section, there was some difficulty in making out its constituent parts, although a judicious use of the polariscope would distinguish grains of quartz from hornblende. It therefore became necessary to adopt some more certain method. The pulverization and sifting of minerals was unsatisfactory, and their chemical analysis was very difficult. The lecturer said very good and certain results could be obtained by means of flame reactions with a Bunsen's burner. A number of experiments were made showing the effects of soda, potash, and lime felspars on the flame, and the effects produced enabled the observer even to approximate to the proportion of the alkalis. In addition to this mode, solutions must be made by dissolving the minerals and crystallizing them under the microscope, when the results would throw further light on the subject. The lecturer concluded by saying that in the way he had pointed out a large amount of knowledge might be gained from a small piece of material, and very valuable aid obtained in the examination of rocks. At the close of the lecture, several solutions were shown crystallizing under the microscopes.

ON KEW GARDENS AND SOME OF THE BOTANICAL STATISTICS OF THE BRITISH POSSESSIONS.*

BY J. G. BAKER, F.R.S., F.L.S.

When our friends come to visit us at Kew it is usually in May, June, or July, when the days are long and the Garden is in its full perfection. But as this is the busiest time of the year I am afraid that the questions they ask are liable to get answered very briefly and incompletely, and if it be a matter where figures are involved it is both difficult to remember them on the spur of the moment, and difficult for the memory, even when they are told correctly, not to mix them up together. I propose, therefore, to occupy my allotted hour this evening in attempting, in the comparative leisure of mid-winter, to answer more fully and precisely than is possible in conversation a few of the principal questions about Kew which are asked most frequently by those who wish to form a full and intelligent idea of the plan and purposes of the establishment.

THE GENERAL PLAN OF THE KEW ESTABLISHMENT.

The aim of a National Botanic Garden is to illustrate as fully as possible the plants and their products, in the first place of the country to which it belongs, and subserviently to this the plants of other parts of the world. First of all we must possess the means of distinguishing from one another and identifying the separate individual kinds of plant, and based upon this follows the investigation of the different points of interest connected with their life-history and various economic uses, as food or clothing, or in medicine and the arts. It is quite safe to say that none but a very limited number of specialists have any idea of the enormous number of different kinds of plants there are in the world. A very moderate estimate, founded on the figures as they stand in Bentham and Hooker's "*Genera Plantarum*" for the flowering plants alone, leaving out of account the ferns, and all the lower orders of Cryptogamia, is 200 natural orders, 10,000 genera, and 100,000 species. Although the possessions of Britain occupy only about one-sixth part of the world, yet they lie so far apart from one another, and under so many different conditions of latitude and longitude and climate, that they

* A Lecture delivered at the Friends' Meeting-house at Westminster, January 26th, 1886, and at the Birmingham Natural History and Microscopical Society, May 29th, 1888.

produce nearly one-half of the whole total number of the plants that are known. For Europe, in an area of under 4,000,000 square miles, there are about 10,000 species of plants known; take 1,500 species as an estimate for the British Isles, and add as many more for Gibraltar, Malta, and Cyprus, and this gives us 3,000 species. For India, where we have every range of climate from equatorial heat to perpetual snow, an estimate of 15,000 species is not excessive. For Cape Colony, and our tropical possessions in Africa, including Mauritius, and the Seychelles, say 2,000 species. For Australia, New Zealand, and Fiji, another 10,000 may safely be added. For the British possessions in North America we may safely say 3,000 species, nearly all of which are amongst the 10,000 which make up the flora of the United States. For the British West Indies and Guiana, 5,000 will not be over the mark, or, to take the British possessions by continents:—

| | | | | | |
|-------------------------|-----|-----|-----|-----|----------------|
| Europe | ... | ... | ... | ... | 3,000 species. |
| Asia | ... | ... | ... | ... | 15,000 „ |
| Africa | ... | ... | ... | ... | 10,000 „ |
| Australia and Polynesia | ... | ... | ... | ... | 10,000 „ |
| America | ... | ... | ... | ... | 8,000 „ |

These numbers add up to 46,000, and in this estimate there will not be a large number of plants counted twice over. Amongst the many excellent things planned by Sir William Hooker was a series of floras, classifying and defining the plants of all the British possessions upon one uniform system. Of these the volumes for Australia, New Zealand, Hong Kong, the West Indies, and Mauritius, are finished; that for India, the most extensive of all, for which Sir J. D. Hooker himself undertook the onerous task of editorship, is far advanced; those for the Cape and tropical Africa are about half finished, whilst the plants of Fiji and the British possessions are fully dealt with in another form, and those of Guiana have been to a considerable extent included in the great flora of Brazil, which has been brought out at the expense of the Brazilian Government.

The objects, as I have already indicated them, of a national botanic garden are at Kew, as at all other fully-equipped establishments of the same kind, carried out by three different departments, as follows: 1st. The Garden, in which a selection of the most interesting plants are cultivated; 2nd. The Herbarium and Library, in which dried specimens of as many different kinds of plants as possible are gathered together, named, and arranged for ready reference, in company with a collection of botanical books and drawings; 3rd. The

Museums, in which the economic uses of the different kinds of plants are illustrated.

During the last ten years these three main essential departments have been supplemented through private liberality with an art gallery and physiological laboratory. I will, in the first place, say a few words about the details of each of these three departments.

THE GARDEN

covers an area of 325 acres, and the grounds of the Queen's Cottage, to which the public are not admitted, are 26 acres more. Whilst a portion of the property was in the hands of Sir Henry (afterwards Lord) Capel, in the reign of Charles the Second, the Garden was already one of the best in the country. Kew House and the surrounding grounds were rented on a long lease by Frederic, Prince of Wales, in 1730, and they were purchased by his son, George the Third, a short time after he came to the throne in 1760. Prince Frederic died in 1751, and his widow, the Princess Augusta, who was a daughter of the Duke of Saxe Gotha, still continued to reside at Kew, and may be looked upon as the real originator of the botanic garden. Her principal adviser, the Earl of Bute, who was Prime Minister for a year in the early part of the reign of George the Third, was an enthusiastic botanist; he spent ten thousand pounds in printing an elaborate botanic work in nine volumes, of which only twelve copies were struck off.

During this middle generation of the eighteenth century the writings of Linnæus gave an enormous impulse to the popularity of botany. The first edition of his "*Species Plantarum*," in which the binominal Latin names of plants were first given to them, was first issued in 1753. For garden plants they were first popularised in England in the eighth edition of the "*Gardener's Dictionary*" of Philip Miller, of Chelsea, published in 1768. In the same year a catalogue of the plants then cultivated in Kew Gardens was published by Sir John Hill. It includes fifty ferns, between 500 and 600 trees and shrubs, and several thousand herbaceous plants. For a long time during the reign of George the Third and his successors, the Garden was managed by the two Aitons, father and son. The elder Aiton was born in 1731, came to England in 1754, entered the service of the Princess Dowager of Wales at Kew, in 1759, and died in 1793. With the aid of Dr. Solander he published, in 1789, a book called "*Hortus Kewensis*," containing descriptive characters of all the plants, 5,600 in number, then cultivated in the Garden.

In 1810, a second edition was published by his son, for the botany of which he was indebted to Dryander and Robert Brown. This contains descriptions of between nine and ten thousand species.

During the reigns of George IV. and William IV. the Garden was very much neglected. In 1840 it was first opened to the public, and was placed under the superintendence of Sir William Hooker. At that time the Garden only occupied an area of eleven acres. Within a few years it was extended by successive additions till it reached the seventy-five acres, which are still enclosed within a wire fence. In 1847 the 250 acres of what was called the Pleasure Ground were added, and were planted as an arboretum, or classified collection of trees. During the twenty-five years of the directorship of Sir William Hooker, the Museum and Herbarium departments were started and organised upon their present footing, and the Palm House, the large Temperate House, and the large Museum, were built, the former at a cost of £30,000. Sir William Hooker died in 1866, and was succeeded by his son, Sir J. D. Hooker, who for several years had filled the post of assistant-director. A very short time ago, after forty-eight years of public service in one form or other, Sir J. D. Hooker resigned the official directorship, and has been succeeded by Mr. W. Thiselton Dyer. The principal additions that have been made during the twenty years of Sir Joseph Hooker's directorship have been the new Herbarium, the Picture Gallery, the Laboratory, the long T shaped house, with varying temperatures, in the centre of the Garden, the Rockery, and the enlargement of the two Museums.

The only old buildings which still remain from the days of George III. are the Pagoda, which was built by Sir William Chambers about 1750, the King's Orangery (now used as a museum for large wood specimens), and various temples and ruins of the style in which our grandfathers delighted. The Tree-fern House near the great gates was sent from Buckingham Palace in the reign of William IV.

The annual number of visitors, which was under 10,000 in 1841, has now risen to over 1,000,000. On the summer Bank Holidays the number has lately varied from 50,000 to 95,000. Exclusive of Bank Holidays, the number of those who visit the Gardens on a Sunday is about as great as on all the other days of the week put together.

Since the institution was re-organised under Sir William Hooker, it has always been kept in view as one of its chief objects that it should be made as useful as possible to the Colonies, and from year to year a large proportion of the time

and thought of the director and assistant-director has been absorbed by their colonial correspondence, and in questioning and answering the questions of their colonial visitors.

STATISTICS OF PLANTS AS CLASSIFIED ACCORDING TO THEIR
CULTURAL REQUIREMENTS.

If we classify plants according to the garden treatment they require, they fall into four main groups: the inter-tropical zone includes a land area of 40,000,000 square miles, and the total number of characteristically tropical plants known to science may be roughly estimated at 40,000 or 50,000. These are provided for at Kew in the Palm House, the Tropical Fern House, the Aroid House near the main gates, the central portion of the new range, and various small propagating houses, which are not open to the public. Of course the expense incurred in cultivating in the English climate any plant of this group is considerable, so that a careful selection from the 40,000 or 50,000 species has to be made.

The second group of plants consists of those that can bear the English summer, but need protection during winter. These are provided for at Kew in the Temperate House, the Succulent House, the cool Fern House, and the cooler parts of the new range. To this group belong the members of the three rich floras of the south temperate zone, where the height of summer corresponds with the depth of our north temperate winter. To this group belong about 30,000 species, or about a third of the plants that are known.

Next come the hardy plants. The north temperate zone occupies about one-third of the earth's surface, and its plants number 20,000 species. Of these at Kew the classified collection of the herbaceous types is contained in what is called the Herbaceous Ground, which is just north of the Cumberland Gate. Here are grown about 2,000 perennials and a thousand annuals, arranged under their respective orders.

The classified collection of shrubs and trees is scattered over the different parts of what was formerly called the Pleasure Ground. For the special growth of Alpine plants two rockeries have lately been laid out. The total flora of the Arctic zone does not reach 1,000 species, and the plants which are confined to the higher levels of the mountains of the north temperate may perhaps be twice as numerous, in all 3,000 species of what gardeners call "Alpines," plants specially adapted to a cold damp climate with a short summer. If we attempt to classify the plants of the British possessions under these four climatic groups, the result will be something like this:—

| | | |
|---------------------|--------|----------|
| Tropical plants ... | 18,000 | species. |
| Half-hardy ... | 18,000 | „ |
| Hardy ... | 8,000 | „ |
| Alpines ... | 2,000 | „ |

46,000 species.

DRAWBACKS OF A BOTANIC GARDEN.

It should be borne in mind that a Botanic Garden, from the nature of the case, differs in many respects from an ordinary garden. Many plants, which it is not worth while for a gardening firm to keep in stock are interesting from their structure or associations. The way to make a fine-looking collection of orchids, or ferns, or palms, is to select a few of the finest kinds, and grow several plants of each, eliminating from the collection altogether the less showy and ornamental kinds. It adds very much to the labour and thought required from the cultivator if a botanical arrangement is followed. For instance, take a genus like *Ranunculus*: some of the species grow naturally in swamps, some in pastures, some in woods, and some in waste ground. If these are grown side by side, the cultivator needs to individualise each species in order to treat it properly. A class of plants which are specially interesting to botanists are those which, either from their size or texture, cannot be properly represented by herbarium species, such as palms, cycads, tree ferns, and succulent plants.

(To be continued.)

ON THE SUCCESSFUL USE OF OIL TO CALM ROUGH SEAS.*

BY W. P. MARSHALL, M.I.C.E.

[NOTE.—The particulars given in this paper have been mainly collected from various published notices.]

The idea of making use of oil to calm and smooth the surface of water is an old one, as illustrated by the well-known old saying about throwing oil on the troubled waters; but it has been only in recent years that the subject has received any serious attention, and it was previously treated as merely fanciful and imaginary. The fact has, however,

* Transactions of the Birmingham Natural History and Microscopical Society, February 14th, 1888.

now become definitely established that there is a great deal of practical value in the idea, and that it admits of being put into use with very important advantage, and of even being instrumental in the saving of life, and the saving of vessels when exposed to rough seas.

Illustrations of this are given by the following cases:— A sailing vessel, the *Stockholm City*, crossing the Atlantic from Boston, encountered a terrible westerly gale, and had no alternative but to drive before it, a course that became extremely hazardous. The captain, therefore, resolved to make use of oil; and a bag of strong sail-cloth filled with tow, well soaked in oil, was suspended at each angle of the stern of the vessel, and allowed to trail in the water; two other bags were placed amidships, and two others at the bows. The action upon the waves is reported as instantaneous; the most dangerous breakers were converted into a harmless swell, and, whilst driving for about 170 miles before the storm, not a sea was shipped.

Another case is that of a sailing vessel, the *Nehemiah Gibson*; the captain, foreseeing a hurricane whilst sailing with the wind astern, and with a heavy sea which became constantly more violent, took two sail-cloth bags, each holding half-a-gallon of porpoise oil, and pierced with holes to allow the oil to leak out gradually. The bags were suspended so as to dip in the water, and the oil produced the desired effect. The huge waves that rushed into the ship's wake, with their breaking and dangerous crests, and rising much higher than the vessel, threatening to overwhelm her, were suddenly pacified as they reached the track of smooth water produced by the oil; the crests of the waves disappeared, and they passed harmlessly under the keel of the vessel.

The value of this method appears most signally where it becomes necessary to rescue the crew of a vessel in distress. The *Martha Cobb*, sailing from Newfoundland to Europe, rescued by this means the crew of a vessel about to founder. Her own cargo was petroleum, and as some of the casks leaked considerably the sea could be smoothed by simply working the bilge pumps. Bringing his ship as near as possible to the wreck, the captain was able to carry off the crew in safety in a very small boat, which would otherwise have been instantly swamped. He considers that, in any tempest or heavy sea, persons may be safely conveyed in boats from one vessel to another, provided the one to the windward makes a judicious use of oil.

For some years past the life-boats on the Australian coasts have succeeded in crossing the reefs in bad weather by

means of diffusing oil upon the water ; and they do this without incurring any danger, and without shipping a drop of water. The oil forms amidst the breakers a smooth track, at each side of which the waves roll over with violence. Crews have been saved out at sea during storms by very small vessels without any danger ; the two ships, lying-to as close to each other as possible, and oil diffused by the one to windward, formed between them a broad smooth track, affording perfect security for the boats. Several vessels loaded with the crews of other ships which had foundered, or had been destroyed by fire, owe their safety entirely to the use of oil, of which there was fortunately a supply on board at the time.

The Hydrographic Office, at Washington, has made a collection of duly authenticated cases of the use of oil ; and Vice-Admiral Cloué, of the French navy, has given in a report upon the subject to the Paris Academy of Sciences, from both of which the above-named cases have been taken. As many as eighty-one such cases of ships safely driving before the wind have been reported, and seventy-two successful cases are also on record where vessels have encountered a head wind safely by the use of oil.

The best oils for the purpose are those of the seal and the porpoise ; mineral oils have been used with success, but they are too light ; and certain vegetable oils, such as that of the cocoa nut, congeal too quickly in cold seas. The hourly consumption of oil for this purpose need not exceed half-a-gallon. The arrangement for the diffusion of the oil, as commonly adopted on board ship, consists of a bag of strong sail-cloth, large enough to hold about two gallons, and filled with tow well soaked in oil. More oil is poured upon the tow, and the bag is sewn up, and its bottom is then pierced with several holes made with a sail-maker's needle. When sailing before the wind, one such bag is suspended at each angle of the stern, and allowed to trail in the water, and another bag is fixed a little forward on each side.

The effects of this simple process are surprising. All the numerous reports that have been collected agree that the oil diffuses itself over the water with extreme rapidity, and that, even when the waves previously seemed ready to swallow the ship, there at once appears a broad track of smooth water, within which all breakers are suppressed.

There is a natural phenomenon, not unknown to seafaring men, that might have sufficed to draw attention to the calming effects of oil half a century ago. Along the Malabar coast there is a certain track where the water is always remarkably tranquil, even during strong south-westerly

monsoons. The sea shows a kind of oily scum, which, as has been ascertained, is derived from springs of petroleum at the bottom, and which prevents the formation of breakers.

The sponge-fishers of Florida make considerable use of oil for the purpose of calming the surface of the water. During the greater part of the year the effect of the slight ripple on the water is easily overcome by a water-telescope, by the aid of which the fishers easily discern the sponges, and hook them up from the bottom. But it sometimes happens in the spring, that the roughness of the sea prevents the handling of both hooks and telescopes. Then the sponge-fisher throws a spoonful of oil upon the waves, which produces a calm about his boat as long as he cares to drift about with it. The oil preferred by the sponge-fishers for this purpose is obtained from the liver of the "nurse" shark; and so effective is this oil considered, that as much as four shillings a gallon is paid for it.

In the use of oil from a ship for calming the surface of the water, there is a difficulty in getting the oil well to windward unless the ship is either at anchor, or lying-to, or running before a gale. There have been two appliances brought out for effecting the distribution of the oil in any direction, without regard to the wind. The first one is specially intended to spread the oil between two ships which wish to communicate with one another in bad weather. The apparatus consists of a mortar and a few shells filled with oil, which are fired to various points on the water between the two vessels, and burst, thus allowing the oil to spread. Should the distance between the two ships be so great that it cannot be covered with oil, the oil from each of the shells would, nevertheless be of considerable use, forming little havens, into which the boat could go, and not only allow the men to rest and recover their strength for further battle with the wind and waves, but also furnish them with a place of comparative security during any exceptionally heavy bursts of the tempest. Under certain circumstances, this apparatus may be used for ensuring the safety of the vessel itself; for instance, when about to pass through a dangerous and narrow channel in bad weather with wind against tide, a few oil-charged shells may be fired ahead of the vessel with considerable advantage.

The second appliance is specially intended to distribute oil on the sea between a stranded vessel and the shore, in those cases when the vessel has no oil on board, and communication by boat is, with the assistance of the oil, practicable. It consists of a mortar and some hundred yards of fine light hose, to one end of which (the end being left open)

is attached a heavy iron weight, so shaped that it can be fired from the mortar. The apparatus is worked as follows :—On a ship going aground near the shore, the weight is fired from the shore as near to the ship as possible; the weight sinks, and acts as an anchor for the hose, through which oil is pumped from the shore. The oil rises near the ship, and being blown towards the shore (in most cases vessels are wrecked on a lee shore) forms a track of fairly smooth water for the boats to traverse. In cases when the whole volume of water rushes along and breaks, the oil has little or no effect, and, consequently, this apparatus would then be useless; but in ordinary broken water, the appliance will, no doubt, be of considerable service.

(To be continued.)

PASSAGES FROM POPULAR LECTURES.

BY F. T. MOTT, F.R.G.S.

VI.—THE UMBELLIFERÆ.

FROM A LECTURE DELIVERED IN 1876.

The ancient Greeks and Romans reckoned among their deadliest weapons the juices of three poisonous plants—aconite, hemlock, and poppy. Of these three the one whose name has come down to us with most historical prestige is hemlock. The world will never cease to remember with shame and grief the death of Socrates, nor that it was by a cup of hemlock juice that that noble life was lost.

This famous hemlock may be taken as a type of an umbelliferous plant, that natural order which is popularly marked by its flowers being produced in umbels. There are plants not of this order which also bear their flowers in umbels, as the ivy, the onion, and the polyanthus. These are not numerous, however, and their umbels are nearly always simple. The true umbellate inflorescence, especially the compound form, is in general a good distinctive character of the order.

Of these umbelliferous plants there are 1,500 species known to exist, which are classified into 150 genera,* showing an average of ten species to a genus, a very usual average

* 1,300 species, 152 genera, according to Bentham and Hooker, *Genera Plantarum*.—[Ed.]

among flowering plants. About sixty species are recognised as natives of Britain, and there are few counties in which half of this number might not be collected.

The region of the earth in which the Umbelliferæ are most common is the northern half of the north temperate zone in the eastern hemisphere. That is to say, the northern parts of Europe and Asia from the Arctic circle to the great mountain chains of the South, the Pyrenees, Alps, Balkans, Caucasus, and Altai. Beyond this district a few species are found as far as South Africa, America, and Australia, but they are only stragglers; the home and centre of the order is Europe and Asia northward of the southern chains. It is the region of cornfields and orchards. South of this region is the home of the Labiates, and north of it the land of Saxifrages. The corresponding region in North America is marked not by Umbelliferæ, which are scarce there, but by some forms of the composites, especially asters and golden-rods (*Solidago*).

The Umbelliferæ, in their native centres, are plants of the lowlands and plains, as in this country and in central Europe. As they travel southward they find the climate too warm for them, and they have to climb the hills for coolness and fresh air. Wherever they can find hills to climb they can live in Southern lands, but as they get nearer the equator, they must mount up higher and higher, till within the tropics such of them as are found at all are met with only on the lofty mountain tops; just as in Great Britain there are several of the Saxifrages found only on the mountains of Scotland and Wales, which inhabit the lowlands further north in Lapland, Russia, and Siberia.

This group of umbel-bearing plants holds an important place in Economic Botany. From it are derived several powerful drugs, gum-resins, volatile oils, and aromatic seeds, while a number of species are cultivated as esculent vegetables and pot-herbs. Among the drugs are assafætida, galbanum, ammoniacum, and opoponax; among the aromatics, carraway, coriander, anise, dill, cummin, and angelica; the vegetables are carrots, parsnips, celery, and samphire, with the old-fashioned alexanders and skirret, now rarely used; and the pot-herbs are parsley, fennel, chervil, lovage, and sweet cicely. Their medicinal and aromatic qualities are due to three kinds of secreted juice, viz.: (1) Acrid watery secretions which are poisonous. (2) Milky and gum-resinous secretions, which are stimulant and antispasmodic. (3) Aromatic essential oils, which are generally pleasant in flavour. Only those species can be used as food in which secretions of the first two forms are absent.

In carrots and parsnips it is the large accumulation of sugar in the tap-root (about one-twelfth part) which makes them valuable. It has been doubted whether the hemlock (*Conium maculatum*) is really so deadly as it was once supposed to be. The qualities of plants often vary with situation and climate. It is said that in Northern Russia the hemlock is mild, and may be eaten. There is no doubt that it is poisonous in this country, and in more southern climates it may possibly be still more virulent. Celery in its wild state is poisonous also; even when cultivated it is still acrid, though less dangerous than when growing wild, but by blanching the juicy leaf-stalks it is found that the acrid secretion is not formed.

Those Umbelliferæ which naturally inhabit central Europe and Britain, are mostly so much alike that, though it is easy to know that a plant belongs to this order, it is difficult to distinguish one species from another; and this is found to be generally the case in any order which has very sharply defined characters, such as the Labiates, the Sedges, and the Grasses. It is easy enough to see that a certain plant is a grass, but *what* grass? That is often a puzzling question to a young botanist. The species are quite distinct, but the distinctions are subtle and minute. The condition of such an order seems to be something like that of a walled city, in which the number of houses can only increase by crowding close together so that you can scarcely tell one from another. The less marked orders are like open towns, built with wide streets and gardens, and suburbs that stretch out towards one another and often actually meet. The buildings having plenty of room are easily distinguishable, wide spaces being sometimes left between them.

But though these Umbelliferæ are mostly so much alike, there are a few odd exceptions. The sea-holly, the marsh pennywort, the astrantia, and the sanicle, are all quite abnormal, and in some distant countries these strange characters are so exaggerated as to make it difficult to recognise the species as Umbelliferæ at all. Plants of this order are nearly all herbaceous, yet there are a few foreign forms which have a shrubby character. They are generally low-growing plants, seldom exceeding 4ft. or 5ft. high, yet there are a few species which run up to 12ft. or 15ft. The Siberian cow-parsnip, sometimes grown in gardens, has herbaceous stems 8ft. or 10ft. high, and umbels a foot in diameter.

It is curious that while these plants exhibit in their leaves a variety of very beautiful forms, they should have so little to show in the way of blossom. Their flowers are all small and

nearly all white, sometimes with a pink tinge, sometimes greenish, yellowish, or bluish, but always individually inconspicuous, and not showy even when clustered together in the umbels. This probably indicates that in the general system of organic evolution the Umbelliferæ have not yet reached the summit of their wave of life; and it may be that, a hundred thousand years hence, when the woods and fields of Europe shall be annually clothed with a glory of blossom such as we do not dream of now, these plants will lift above the lovely masses of their foliage gorgeous umbels of large bright flowers, rivalling the roses and lilies of to-day.

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, B.A., AND J. E. BAGNALL, A.L.S.

(Continued from page 152.)

Sub-genus V.—CLITOCYBE.

59. **Ag. nebularis** *Batsch*. In woods. Rare. Sept.-Oct. The Spring, Kenilworth, *Russell, Illustr.* Sutton; Water's Wood, Maxtoke; Cut Throat Coppice, Solihull.
60. **Ag. clavipes**, *Fr.* Woods. Rare. Trickley Coppice, 1883; Harding's Wood, near Maxtoke; Packington Park.
61. **Ag. inornatus**, *Sow.* Amongst grass. Rare. Oct. Birmingham Road, Kenilworth, *Russell, Illustr.* Hopsford, near Brinklow, *Adams*.
62. **Ag. odoratus**, *Bull.* Moist woods. Local. Aug.-Oct. Oversley Wood, *Purt.* ii., 624. Ragley Wood! *Purt.* iii., 394. Birmingham Road, Kenilworth, *Russell, Illustr.* Combe Ridings, *Adams*. Bentley Park, near Atherstone! *Bloxam*, Sept., 1849. Banks near the entrance to Packington Park.
63. **Ag. cerussatus**, *Fr.* Woods and shady places. Rare. Oct. Near Kenilworth, October, 1850; The Briars, Kenilworth; Field Gate and Red Lanes, near Kenilworth, *Russell, Illustr.* Near Sutton Park.
64. **Ag. phyllophilus**, *Fr.* Amongst leaves in woods. Sept.-Oct. Hedge bank, the Spring, Kenilworth; Crackley Wood! *Russell, Illustr.* Combe Ridings, *Adams*. Sutton Park; Trickley Coppice; Water Orton; Marston Green; Cut Throat Coppice, Solihull; Haywood.
65. **Ag. pithyophilus**, *Secr.* Fir woods. Rare. Sept.-Oct. Combe Abbey Pool, *Adams*. Trickley Coppice; New Park, Middleton.

66. *Ag. candicans*, *Pers.* Amongst leaves in woods. Oct. Burton Green Wood, near Kenilworth, *Russell, Illustr.* Crackley Wood, Kenilworth, collected with Dr. Cooke.
67. *Ag. opacus*, *With.* Grassy places among trees. Very rare. Edgbaston Park, *With.*, 180. Red Lane, Kenilworth, *Russell, Illustr.* "I have found some specimens in Sutton Park, which, I believe, belong to this species." — *W.B.G.*
68. *Ag. dealbatus*, *Fr.* Woods. Rather rare. Oct. Combe Fields, *Adams.* Lower Holly Hurst, Sutton Park; Shawberry Wood, Shustoke.
69. *Ag. gallinaceus*, *Scop.* Pastures. Sept.-Oct. Pastures, Kenilworth, *Russell, Illustr.* Sutton Park.
70. *Ag. fumosus*, *Pers.* Heaths. Rare. Oct. Kenilworth Common, *Russell, Illustr.* Ansty, *Adams.*
71. *Ag. giganteus*, *Fr.* Woods and meadows. Oct. In a meadow, close to a high hedge, at Mr. Bamford's, Middletown, *Purt. ii.*, 629. The Dale, Kenilworth, *Russell, Illustr.* Corley, *Adams.*
Fries places this species under *Paxillus*.
72. *Ag. maximus*, *Fr.* Wood borders. Oct. Borders of Crackley Wood, Kenilworth, *Russell, Illustr.* Roadside by Combe Woods, *Adams.*
73. *Ag. infundibuliformis*, *Schæff.* *Ag. membranaceus*, *With.* Woods. Oct. Local. Edgbaston! Packington Park! *With.*, 159. Crackley Wood, under felled trees in Red Lane, Sept., 1871, *Russell, Illustr.* Gulley Common, near Nuneaton, 1849, *Bloxam.* Combe, *Adams.* Bentley Park; North Waste Wood, Tile Hill; Haywood; Four Oaks; Coleshill Pool.
74. *Ag. geotropus*, *Bull.* Woods. Very rare. Oct. Kenilworth, Sept., 1850, *Russell, Illustr.*
75. *Ag. inversus*, *Scop.* Woods. Not common. Oct. Abbey Hill, Kenilworth; Crackley Wood, *Russell, Illustr.* Combe Road, and Ansty, *Adams.* In clusters, Sutton Park.
76. *Ag. flaccidus*, *Sow.* Woods. Rare. Oct. Discovered by Mrs. Rufford in Ragley Wood, *Purt. iii.*, 186 Fillongley, *Adams.*
77. *Ag. catinus*, *Fr.* Woods. Very rare. Crackley Wood, Kenilworth! *Dr. Cooke.*
78. *Ag. tuba*, *Fr.* Woods. Rare. Trickley Coppice, Middleton! *Dr. Cooke.*
79. *Ag. cyathiformis*, *Fr.* *Ag. sordidus*, *Dicks.*, *With.* Meadows. Local. Oct.-Nov. Pastures, Edgbaston,

- With.*, 197. In my own field at Oversley, *Purt.* iii., 197. Combe, *Adams.* Kenilworth, tan heaps; Birmingham Road, Kenilworth, *Russell, Illustr.* Sutton; Sutton Park; Small Heath; Harding's Wood, Maxtoke.
80. **Ag. brumalis**, *Fr.* *Ag. cyathiformis*, Bull.,* *With.*, *Purt.* Open places in woods. Local. Oct.-Dec. Pastures, Edgbaston, *With.*, 153. Oversley Hill; Coughton Park; Ragley Woods, *Purt.* ii., 623, obs. iii., 182. Burton Green Wood; Crackley Wood, Kenilworth, *Russell, Illustr.* Combe Ridings, *Adams.* Sutton Park; Edgbaston Park; Trickle Coppice; Olton Reservoir; pine wood, Coleshill Heath.
81. **Ag. metachrous**, *Fr.* Woods. Local. Sept.-Oct. Among trees, the Spring, Kenilworth, *Russell, Illustr.* Trickle Coppice; New Park; Middleton Heath; Bradnock's Hayes; pine wood, Coleshill Heath; Whey-porridge Lane, Solihull.
Var. *obsolescens*, Batsch. In the Park at Packington, *With.*, 187. Probably, as he quotes the figure of Batsch (f. 102).
82. **Ag. ditopus**, *Fr.* Pine woods. Rare. Oct. Sutton Park, *Dr. Cooke.* Edgbaston Park; Trickle Coppice; Middleton Heath; pine wood, near Coleshill Pool.
83. **Ag. fragrans**, *Sow.* Woods. Local. Aug.-Oct. Edgbaston Park, under Spanish chestnut trees, *With.*, 158. The Spring, Kenilworth, *Russell, Illustr.* Combe, *Adams.* Coppice, near New Park, Middleton; the Shawberries, Shustoke.
84. **Ag. obsoletus**, Batsch. Very rare. Sept. Slope of the boat-house field, Edgbaston, *With.*, 200.
85. **Ag. laccatus**, *Scop.* Woods. July-Oct. Common and very variable. *Ag. rosellus*, *With.*, 167. Edgbaston! *Ag. livido-purpureus*, var. 2, *With.*, 256, and *Ag. subcarneus*, ib. 260, Edgbaston and Packington Parks! *Ag. farinaceus*, *Purt.* ii., 640, Alcester Heath; side of road to Stratford. Warwick, *Perceval.* Kenilworth, *Russell, List.* Combe, *Adams.* Sutton Park; Trickle Coppice; Bentley Park; Olton, etc., etc.
Var. *amethystinus*, Bolt. Often with the type. Plantations, Edgbaston! *With.*, 176. Oversley and Ragley Woods, *Purt.* ii., 628. Sutton Park; Edgbaston Park; Packington Park; New Park; Coleshill Heath, etc.

* The quotation of "Bull, t. 278, A.B." in *Fr. Hym. Eur.*, p. 103 (repeated by Stevenson, p. 91), is a misprint for t. 248, A.B.

Sub-genus VI.—COLLYBIA.

86. **Ag. radicans**, *Relh.* *Ag. umbraculum*, *With.* On bare ground. Local. Aug.-Oct. Church Lane, Edgbaston! *With.*, 158. Plantation, near Dunnington, *Purt.* ii., 637. The Brays, Kenilworth, *Russell, Illustr.* Warwick, *Perceval.* Ansty, *Adams.* Pool Hollies Wood, Sutton Park; Windley Pool; field, near Crackley Wood, Kenilworth; Packington Park; New Park, etc.
87. **Ag. platyphyllus**, *Fr.* Woods. Local. Oct. Sutton Park (*repens*); Trickley Coppice; New Park; Kingsbury Wood; Bentley Park; Marston Green.
88. **Ag. fusipes**, *Bull.* *Ag. elasticus*, *With.* *Ag. crassipes*, *With.*, *Purt.* Stumps and under trees. Aug.-Oct. Edgbaston Park, *With.*, 181, 186. Oversley Hill; Sperm Lane, *Purt.* ii., 630, and var. *elasticus*, Oversley Lodge, iii., 199. Birmingham Road, Kenilworth, *Russell, Illustr.* Warwick, *Perceval.* Combe; Corley, *Adams.* Ham's Hall, *Hawkes!* New Park, Middleton; Ironstone Wood, Oldbury; Pool Hollies Wood, Sutton; Packington Park.
89. **Ag. maculatus**, *Alb. et Schwein.* Woods. Not rare. Oct. The Spring, Kenilworth; Crackley Wood! *Russell, Illustr.* Combe Ridings, *Adams.* Sutton Park; New Park; Trickley Coppice; Coleshill Pool and Heath; Ironstone Wood, Oldbury; Four Oaks; Bradnock's Hayes.
90. **Ag. butyraceus**, *Bull.* Woods. Oct. Local. Crackley Wood, Kenilworth, *Russell, Illustr.* Combe Ridings, *Adams.* School Close, Rugby, *Rugby School Rep.* Sutton Park; Water Orton; School Rough, Marston Green; Shawberry Wood; coppice, Whey-porridge Lane, Solihull; Edgbaston Park; New Park; Bradnock's Hayes; Water Orton.
91. **Ag. velutipes**, *Curt.* *Ag. sulcatus*, *With.* Logs, etc. Frequent. Oct.-Apr. Edgbaston, *With.*, 229. Kenilworth, *Russell, List.* Warwick, *Perceval.* Ansty, *Adams.* Driffold Lane; Sutton Park; near Olton Reservoir; Shirley Heath; Marston Green; Castle Bromwich, etc.
92. **Ag. vertirugis**, *Cooke.* Decayed fern roots. Rare. Crackley Wood, Sept., 1861, *Russell, Illustr.*
93. **Ag. hariolorum**, *DC.* *Ag. nemoralis*, *With.* Woods. Very rare. Oct. Edgbaston, *With.*, 234.
94. **Ag. confluens**, *Pers.* Amongst leaves in woods. Rare. Binley Woods, near Coventry, *Adams.* Edgbaston Park.
95. **Ag. conigenus**, *Pers.* *Ag. hippopinus*, *With.* On the cones of Scotch fir, in Packington Park, *With.*, 199.

96. *Ag. cirrhatus*, Schum. Amongst leaves. Rare. Combe Ridings, Adams. Holly Hurst, Sutton Park; exactly as figured in *Cooke's Illustr.* t. 144B.
97. *Ag. tuberosus*, Bull. On dead *Russulæ*. Rare. Aug.-Oct. New Park, Middleton; School Rough, Marston Green; pine wood, Coleshill Heath.
98. *Ag. collinus*, Scop. Grassy places. Rare. Sept. The Spring, Kenilworth, Russell, *Illustr.* New Park, Middleton; named by Dr. Cooke.
99. *Ag. tenacellus*, Pers. Rare. Warwick Castle Grounds, Perceval.
100. *Ag. acervatus*, Fr. Woods. Rare. Aug. Wood, Dale House Lane, Kenilworth, Russell, *Illustr.*
101. *Ag. dryophilus*, Bull. Amongst leaves in woods. Frequent. Aug.-Oct. Edgbaston, *With.*, 284. Ragley Woods; Oversley Wood, *Purt.* iii., 228. Crackley Wood! the Spring, Kenilworth, Russell, *Illustr.* Combe, Adams. Sutton Park; New Park; Trickle Coppice; Baddesley Park; Packington Park, etc.
In Trickle Coppice and near Coleshill Pool there occurs a form of this which appears to be *Ag. aquosus*, Bull.
102. *Ag. rancidus*, Fr. Woods. Rare. New Park, Middleton.
Ag. inolens, Fr. Garden, Claverdon Villa, Kenilworth, Russell, *Illustr.*; is probably a mistake.

(To be continued.)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 159.)

- * *Rubus Idæus*, 166. Bishop's Wood, near Hartlebury, Bromsgrove Lickey, and Shrawley Wood. S.G.
- * *R. glandulosus*, 166. On Bromsgrove Lickey. L.M.
- * *Rosa spinosissima*, 165. Near Crookbarrow Hill, in abundance, and about Nunnery Wood, Hallow, and Craycombe. S.G.
- * *R. Doniana*, 165. (Form of *R. involuta*.) Craycombe, Crookbarrow Hill, and Battenhall. S.G. as *R. gracilis*.
- * *R. villosa*, 165. In Hindlip Wood, near Worcester, and between Bromsgrove and Hagley. S.G. L.M.
- * *R. tomentosa*, 165. At Bransford, Fernhill (Fernall) Heath, and between Malvern and Cowleigh Park. S.G. L.M.
- * *R. Sherardi*, 165. Powick. S.G. (*R. tomentosa*, var. *subglobosa*. Baker.)

- * *R. rubiginosa*, 166. In a hedge between St. John's and Pitmaston. On Ankerdine Hill, and near Crookbarrow. S.G. L.M.
- * *R. micrantha*, 166. On the Warren Hill, southward of Little Malvern. S.G. L.M.
- R. dumetorum*, 166. (*A form of R. canina.*) Between Worcester and Malvern.
- * *R. Borreri*, 166. (*A form of R. canina.*) Side of Perry Wood, and in woods near Malvern. S.G. L.M.
- * *R. arvensis*, 166. Abundant on the Abberley Hills, and on the Berrow Hill, Martley, &c.
- † *Mespilus germanica*. Medlar. 164. Exceedingly rare. In a coppice bordering Deehurst Lane, opposite the Lower Lode, near Tewkesbury, a spot almost overgrown with underwood, the lane being merely a rough horse track. The *Cynoglossum sylvaticum* grows in the same lane. Mr. Lees. *This habitat is in Gloucester.*
- * *Pyrus torminalis*, 165. On the red marl cliff at the Ketch, and occupying the dizzy summit of Blackstone Rock, near Bewdley. S.G. L.M.
- * *P. domestica*, 165. In the middle of Wyre Forest, near Bewdley. First noticed there by Alderman Pitts, in 1678. Recently visited by Mr. Lees, who reports it to be in a state of decay, and some wood cutters having recently made a fire against its weather-beaten trunk, its destruction seems impending. S.G.
- * *P. communis*, 164. Perry Wood. *Worc. Misc.*
- * *P. Malus*, 164. Common enough in its genuine austere state. *Worc. Misc.*
- * *Oenothera biennis*, 161. Appearing occasionally on suspicious spots within sight of gardens. A single specimen on the bank of the Teme below Powick Bridge. S.G.
- * *Circæa lutetiana*, 149. Perry Wood, Shrawley Wood, and other moist shady places. S.G. L.M.
- Hippuris vulgaris*, 149. Rare. Clifton-upon-Severn. Dr. Streeten.
- Ribes Grossularia*, 157. A frequent straggler from gardens, and an epiphyte on old willows, but occurring also in less suspicious habitats.
- R. rubrum*, 156. In the deep dingle of a wood at Hailstone Hill, near Suckley. Also in a ravine at Clifton-on-Teme, between that place and St. Catherine's Well.
- R. nigrum*, 157. On the banks of the Severn in several places.
- * *Sedum Telephium*, 163. Shrawley Wood; marsh close to Laughern Brook, Worcester, and the rocks at Malvern. S.G. L.M.
- * *S. album*, 164. On the rocks of the North Hill, Malvern. L.M.
- * *S. reflexum*, 164. On the Abbeys at Great and Little Malvern.
- * *Cotyledon Umbilicus*, 163. In the fissures of the greenstone and granitic rocks at Malvern. Growing very luxuriantly in a lane leading to the Giant's Grave, at Habberley, near Kidderminster. S.G. L.M.

- Saxifraga tridactylites*, 162. Adorning the wall fronting the bank of the Teme at Powick Bridge; but the river having now undermined the wall, it has fallen down, and the plant is gone with it.
- * *S. granulata*, 162. Not uncommon. In a meadow near Laughern Brook, at Bevere, near Droitwich, Habberley, &c.
- * *Chrysosplenium alternifolium*, 162. In a marsh near Leigh Church. Also by a stream in Shrawley Wood.
- * *Apium graveolens*, 158. Abundant by the side of the Droitwich Canal.
- * *Sium* (*Helosciadium*) *repens*, 158. On the Malvern Hills, among the trickling springs. L.M.
- * *S. latifolium*, 158. By the weir at Newman's Bridge, near the Devil's Den, Clifton-on-Teme. Mr. Lees. S.G.
- * *S. angustifolium*, 158. Near Bransford Bridge and at Powick Weir. Also by a pool near Bromwich Farm. S.G.
- Carum Carui*, 158. Meadows near Worcester.
- * *Pimpinella Saxifraga*, 158. Dry banks on the Leigh Sinton, and other roads, and elsewhere, very common.
- * *P. magna*, 158. On the limestone hills near Suckley.
- Bupleurum tenuissimum*, 159. Found by Mr. Addison, of Malvern, on the common between Malvern and the Rhydd.
- * *Ænanthe pimpinelloides*, 158. In some abundance in a meadow at the north-western base of Crookberrow Hill. Mr. Lees.
- * *Æ. Phellandrium*, 158. In a pool on Powick Ham. S.G.
- Pastinaca sativa*, 159. Road side near Stoughton, abundantly. Battenhall, Craycombe, &c., on red marl and lias marl.
- * *Torilis nodosa*, 157. Hedge side on the Spetchley Road. Hedge, road side, near the Ketch, on the Bath Road.
- * *Chærophyllum sativum*, 157. In great profusion on the sides of the Tewkesbury Road, just beyond the Turnpike, Worcester. First noticed by Dr. Stokes in 1775. Still there in equal profusion in 1828. Mr. Lees. But in 1830 the road was altered at this point and lowered, the bank thrown down, a wall built, and every vestige of the plant destroyed. S.G.
- * *Smyrnium Olusatrum*, 158. In great abundance at Hill Croome, and about Pershore.
- * *Adoxa Moschatallina*, 162. By the Paper Mill at Alfrick, but scarce about Worcester. Abundant in the vicinity of Bromsgrove, according to Mr. Maund.
- * *Viburnum Lantana*, 159. By the road side at Craycombe. S.G. L.M.
- †* *Galium pusillum*, 153. Hedgerow on the side of Red House Lane, Worcester. Dr. Stokes. Now exterminated. *An error. See note to same plant in the "Strangers' Guide."*
- * *Asperula odorata*, 153. Woods on the old Storage Hill. Also about Southstone's Rock, and Wassel Hill, near Bewdley. Woods at Stanford, and on Ankerdine Hill. S.G. L.M.
- * *A. cynanchica*, 153. Bredon Hill. Dr. Streeten.

- * *Valeriana rubra*, 150. On the wall close to the western entrance of Worcester Cathedral, 1826. The plant has since disappeared. S.G.
- * *V. dioica*, 150. In a marshy field close to Laughern Brook, near Worcester, above Bubble Bridge. S.G.
- * *V. officinalis*, 150. Nunnery Wood, and the banks of the Severn. The narrow-leaved variety on Bredon Hill. S.G.
- * *Dipsacus pilosus*, 152. In great abundance by the side of the lane below the Abbey Church, Malvern. Brook at Kempsey. S.G. L.M.
- * *Scabiosa succisa*, 152. Moist pastures near Worcester. S.G.
- * *Carduus Marianus*, 174. On the marly bank by the side of the London Road, at Red Hill, near Worcester.
- * *C. acanthoides*, 174. In the hedges near the Severn, below Worcester.
- * *C. eriophorus*, 174. On the road from Worcester to Norton. Mr. Lees.
- * *C. pratensis*, 174. By the brook at Upton Snodsbury.
- * *C. acaulis*, 174. On Welland Common, near Little Malvern.
- * *Carlina vulgaris*, 174. On the Malvern and Abberley Hills, &c. L.M.
- * *Serratula tinctoria*, 174. Borders of Perry and Nunnery Woods, &c. Abundant on the bank at Rainbow Hill, previous to the alteration of the road.
- Matricaria Chamomilla*, 175. On Welland Common, and other waste spots about the eastern base of the Malvern Hills.
- * *Tanacetum vulgare*, 174. Very abundant on the banks of the Severn and Teme.
- * *Anthemis nobilis*, 175. On the Link, at Great Malvern, and on other commons about the Hills. L.M.
- Achillæa Ptarmica*, 175. Corn field at the Rhydd. Dr. Streeten. Also at Battenhall and Little Malvern.
- Artemisia Absinthium*, 174. About Malvern and Alfrick, near farm houses. Recorded by Scott without locality.
- * *Gnaphalium rectum* (*G. sylvaticum*, L.), 175. In Shrawley Wood. Mr. Lees.
- * *Bidens cernua*, 174. Ponds in the vicinity of Martley. In a ditch near Pitmaston.
- * *Inula Helenium*, 175. In the meadow at the back of Mr. Harris's Farm House, near Stanford Bridge, between Clifton and Stanford, according to the late Mr. T. B. Stretch, of Worcester.
- * *Solidago Virg-aurea*, 175. On the rocks at Malvern, and in the adjacent Woods. Coppice near Bewdley. L.M.
- Tussilago Petasites* (*P. vulgaris*, Desf.), 175. Rather local upon the banks of the Teme. By the side of the brook at Alfrick. Banks of the Severn opposite Cleveload. Skirting the entire course of the brook at Sapey.

- * *Cichorium Intybus*, 174. Border of a corn field near Pendock. Dr. Streeten. Also near Crookbarrow Hill.
- *† *Hieracium murorum*, 174. On the rocks at Malvern. L.M. *An error, I think, for H. vulgatum.*
- * *Jasione montana*, 155. In Shrawley Woods, and other sandy places.
- *† *Campanula glomerata*, 155. Near Knightford's Bridge. S.G. (*Must be an error.*)
- * *C. latifolia*, 155. Shrawley Wood, where the sandstone cliff shelves down towards the Severn.
- * *C. patula*, 155. Abundant in the hedges about Newtown, and in almost all our woods. S.G.
- * *Vaccinium Oxycoccos*, 161. Bogs on Bromsgrove Lickey.
- * *V. Myrtillus*, 161. Abundant in Bewdley Forest and on the Bilberry Hills, Bromsgrove Lickey. Also on rocks on the Malvern Hills, but sparingly there. L.M.
- † *Menziesia polifolia*, 161. On the Lickey Hill near Bromsgrove. Mr. Lees. It is to be feared now extirpated, the road having since been altered. (*Must be an error.*)
- * *Erica Tetralix*, 161. Abundantly on Bromsgrove Lickey, but not on any part of the Malvern Range.
- * *E. cinerea*, 161. Bromsgrove Lickey, and various heaths in the northern parts of the county.
- * *Pyrola media*, 162. Wyre Forest, near Bewdley. Dr. Pratinton.
- * *P. minor*, 162. Shrawley Wood. Mr. Lees.
- * *Monotropa Hypopitys*, 162. At the roots of the beech trees in the plantations at Middle Hill, Broadway. Sir Thomas Phillips, Bart.
- Ligustrum vulgare*, 149. Abundant in the hedges.
- * *Vinca major*, 157. Between Cotheridge and Broadwas, by the road side. Hedge bank, near Little Malvern Church. S.G.
- * *V. minor*, 157. In the woods near Leigh Sinton, unquestionably wild. Hedge bank at Little Malvern. Also in profusion at the base of Crookbarrow Hill. S.G.
- * *Chlora perfoliata*, 161. At Craycombe, Abberley, Clifton, &c. L.M.
- * *Gentiana Amarella*, 157. On the wooded limestone ridge at the western base of the Worcestershire Beacon, Malvern. L.M.
- * *Menyanthes trifoliata*, 154. In a pool on Hartlebury Common.
- * *Cuscuta europæa*, 157. Very rare. At Shipston-on-Stour, according to the Rev. Dr. Jones. *This is the record in Smith's "English Flora," 1824.*
- * *Datura Stramonium*, 156. Occasionally appearing on manured soil, near Worcester, but not really a native. S.G. L.M.
- * *Atropa Belladonna*, 156. Dudley Castle. Also on a wall at Lincombe, near Hartlebury, where it has flourished for many years, according to Dr. James Nash.

(*To be continued.*)

NOTES UPON THE RECENT OCCURRENCE
OF PALLAS' SAND GROUSE.*

BY R. W. CHASE.

At the end of last month another irruption of Pallas' Sand Grouse, *Syrnhaptés paradoxus*, took place in this country, similar to that which occurred in 1863. Curiously enough, the date of their arrival on the present occasion was almost identical with that of twenty-five years ago.

Professor Newton intimated that in all probability another invasion would take place, as he considered that the cause of this species appearing in Europe was the inordinate increase in their natural habitat—the Steppes of Tartary; and that unless some unforeseen circumstance checked their increase, we might expect another immigration of their surplus, which prophecy has been amply fulfilled during the last few weeks.

I cannot help thinking that the cause of this Asiatic species visiting Europe is more likely to be some climatic influence, such as wind or extreme cold, which diverted the flocks when moving to their breeding stations, and caused them to look for a suitable district in another direction; because if it were a matter of surplus population only, surely their hereditary habitat would become over-stocked within a less period than twenty-five years.

Pallas' Sand Grouse is an attractive species, irrespective of its rarity in our islands, possessing some most interesting characteristics, especially the formation of the foot, in which the toes are united together, forming a sole with a rugous horny covering, the hind toe being wanting, and the legs are completely feathered down to the toes. The power of flight must be immense, judging from the elongation of the primaries and depth of keel of sternum. I have received numerous letters informing me of the occurrence of these Sand Grouse in different parts of the country, and as it is desirable to obtain as complete a record as possible, perhaps the following may be of interest:—On the 18th of May, a male shot at Welwich, near Patrington, out of a flock of about twenty. On the 22nd, a female shot at Spurn, out of a flock of seven, and same day seven were seen on the Denes at Yarmouth. On the 24th, a female shot at Rough Hills, Wolverhampton. On June 1st, a flock on Holy Island, of which several were shot. Same day four were shot at Horsey. Norfolk. On the 2nd, fourteen were seen at Fleg

* Read before the Birmingham Natural History and Microscopical Society, 12th June, 1888.

Burgh; also, a small flock on the Denes at Yarmouth. On the 5th, a female was shot in Shropshire. On the 7th, a female shot near Flamborough, and a male the following day at same place. I also have had word sent me that a nest containing three eggs has been taken in Norfolk, showing that if protection were afforded them the Sand Grouse would breed here; and if it should be possible to acclimatise them they would be a valuable addition to our avifauna, feeding as they do upon small seeds and grasses—not grain, at least I have found none in those crops I have examined,—and would probably assist in destroying noxious weeds.

BOTANICAL NOTES FROM SOUTH BEDS.

Amongst the self-imposed duties of an observer of nature are included careful records of the appearance of alien and the extinction of native plants. The latter, to put it mildly, is a less agreeable task than the former, and it is to record an instance of this kind that these notes are made. During the last few years rumours have been rife that it was intended to enclose much of Totternhoe Common land, and a visit during the present month of May, 1888, has revealed changes that, although they might appeal sympathetically to the utilitarian spirit of the age, yet evoke feelings of keen regret from the lovers of nature's quiet haunts. One could forgive the diversion of tortuous roads, the stoppage of little-used paths, but the conversion of a favourite haunt of some of our rarest native plants into an arable field, implies an irreparable loss from a naturalist's point of view. Lying between Totternhoe and Eaton Bray, there has existed a low, boggy meadow, which is now in the course of being turned into arable land. An enumeration of some of its more striking plants will give some idea of the richness of its organic contents. Such are *Anagallis tenella*, *Parnassia palustris*, *Pinguicula vulgaris*, *Menyanthes trifoliata*, *Orchis latifolia*, *Carex panicea*, *C. binervis*, and last, which is the most noteworthy, *Hypnum Sendtneri*, for it is to be feared that this rare moss must now be regarded as extinct in the county of Beds. Of the other plants, the Bog Pimpernel and the Butterwort, there are in this county at least one other station for each, viz., Heath and Reach for the former, and Markham Hills for the latter. On carefully examining the upturned sods of the Totternhoe mead, one detected at the visit in question some half dozen plants of the *Pinguicula*, which were carefully removed to an adjoining meadow, which is enclosed as a pasture, where it is hoped they will continue to exist. But of *Hypnum Sendtneri* not a trace could be found, as the ditch in which it grew was filled with soil. As a further illustration of the varied forms of life of this field, it may be mentioned that the surface of the prepared soil was literally strewn with the blanched shells of molluscs, chiefly consisting of *Succinea elegans*, *Carychinm minimum*, *Helix hispida*, *H. sericea*, *H. pulchella*, and *Cochlicopa lubrica*. There was a small compensating record made on the same occasion that somewhat diminished one's regret, viz., the occurrence, in an adjoining meadow, of *Polygonum bistorta*, which was known only to grow near Luton in S. Beds, in a field that will probably soon be built upon.

JAS. SAUNDERS, Luton.

Wayside Notes.

WE OBSERVE that Mr. Chas. B. Plowright, of King's Lynn, the well-known micro-fungologist, proposes shortly to publish an account of the British Uredineæ and Ustilagineæ. The work, which will be published as soon as the requisite number of subscribers has been obtained, besides containing descriptions of the British species of these fungi, will also give a full account of their biology (as far as this is at present known), including the methods of observing the germination of their spores, and of their experimental culture. The publishers are Messrs. Kegan Paul, Trench, and Co.

AMONGST THE NEWLY-ELECTED FELLOWS of the Royal Society we are very glad to recognise two local scientists, viz., Professor Poynting, D.Sc., and Professor Lapworth, LL.D., F.G.S., both of the Mason College, Birmingham. The physical work of the former of these lies outside the sphere of criticism of the "Midland Naturalist," though, as secretary to the Birmingham Philosophical Society, his name is well known to many of our readers; Dr. Lapworth, however, is *par excellence* a field naturalist, and in the Midland district, as in North and South Scotland, has done much good work in unravelling vexed geological questions.

ATTENTION HAS BEEN DRAWN in the *Times* and other papers to the serious defoliation of the oak in many districts through the ravages of a small blackish-green caterpillar. These ravages are particularly noticeable in the park at Sutton Coldfield, where large masses of the trees are as leafless as in mid-winter. Walking through the woods in the first week in June, the caterpillars were seen to hang literally in ropes from the trees, and an open umbrella was the only way in which progress could be made possible to ladies.

SPEAKING OF TREES, probably most of our readers have noticed the extraordinary abundance this year of the flowers of the holly. In many bushes the leaves have been, at a few yards distance, completely lost sight of amongst the dense tufts of the whitish flowers. If the promise of the spring is fulfilled in the autumn, berried holly ought next Christmas to be a drug in the market, and, according to the popular superstition, the approaching winter ought to be one of marked severity. Possibly, though, the relative poverty of hawthorn flowers may correct the prevalence of those of the holly, and we may be favoured with an open winter after all.

IT IS INTERESTING to note that this year the flower known, sarcastically no doubt, as "May," did not put in an appearance till the end of that month, and was not in full beauty in the central Midlands till mid-June. In full accord with this, however, the writer of these notes picked his last Poet's Narcissus, just expanded, on Midsummer day.

WE HOPE OUR READERS will not forget the meeting of the Midland Union of Natural History Societies, at Northampton, on July 4th and 5th, but will take care to make it as successful in point of numbers as it seems certain to be in point of interest. We are requested to mention that the price of tickets for the Botanical and Geological Excursions will be 7s. 6d. each; not 8s. 6d as stated last month.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—BIOLOGICAL SECTION, May 8th. Mr. W. B. Grove, B.A., in the chair. The following were exhibited by Mr. W. B. Grove:—Fungi, *Puccinia liliacearum*, from Lytham, *Peronospora valerianellæ*, new to Britain, and *P. Lamii*, from Kirkbride, collected by Rev. Hilderic Friend; for Mr. S. Bolton, *Pocillum Boltonii*, a new and interesting aquatic fungus, first found by the late T. Bolton at Hill Oak, near Sutton. By Mr. Collran Wainwright, Lepidoptera: *Hibernia progemmaria*, *H. defoliaria*, *Bombyx neutria*, *Miana strigilis*, to show variation, and *Sphinx Convolvuli*. By Mr. J. E. Bagnall, a number of mosses and lichens from Preston Bagot, including *Scleropodium cæspitosum* in fruit; for Rev. D. C. O. Adams, M.A., *Hypnum glareosum* and other mosses, from Bournemouth; for Mr. S. Walliker, *Hookeria lucens* from Cwm Rhaiadr, North Wales; for Father Reader, a number of mosses and hepatics from Woodchester, Gloucestershire. The President, Mr. W. B. Grove, then read a paper by Rev. W. Hunt Painter, "Notes on the Flora of Settle," illustrated by specimens. The paper gave an interesting account of a part of Yorkshire, formerly worked by Mr. John Windsor, F.L.S., and later botanists, to whose record Mr. Painter was able to make several additions. A discussion followed, in which Messrs. W. B. Grove, C. Pumphrey, and J. E. Bagnall took part, and a vote of thanks was accorded to Mr. Painter for the trouble he had taken in preparing and illustrating the paper.—June 12th. Mr. R. W. Chase in the chair. The following were exhibited:—By Mr. W. B. Grove, B.A., for Mr. W. R. Hughes, *Peziza coronaria*, a beautiful cup fungus, the largest of its kind in Britain. By Mr. Herbert Stone, *Geranium sylvaticum*, *G. lucidum*, *G. columbinum*, *G. sanguineum*, *Teesdalia nudicaulis*, *Sedum Rhodiola*, and many other rare plants, from various localities. Mr. W. P. Marshall, M.I.C.E., *Pavia flava*, or smooth horse chestnut, a native of Georgia. Mr. C. Pumphrey, an abnormal *Antirrhinum majus*, in which the lower lip of corolla was divided into three distinct petals; a series of *Aquilegias*, in which a wonderful variation in duplication and suppression was noticeable; also, a beautiful series of Swiss Alpine plants, including *Edelweiss*. Mr. R. W. Chase, *Syrnhaptes paradoxus*, the sand grouse, male and female, with a very interesting account of the habits and distribution of these birds. Mr. J. E. Bagnall, A.L.S., flowering plants, mosses, and lichens, from the Stour, Alne, and Cherwell basins in Warwickshire; for Rev. D. C. O. Adams, a fine series of mosses, including *Ulota intermedia* and *Hypnum loreum*, from near Tetsworth, Oxfordshire; for Mr. Walliker, *Scilla verna*, *Armeria maritima*, and mosses and lichens, from Land's End; for Father Reader, *Graphis elegans*, *Sticta pulmonaria*, and other lichens, from near Woodchester, Gloucestershire. Mr. W. B. Grove then read his paper, "Notes on some Plants of the Rhine Land," illustrated by a beautiful series of specimens; the paper was full of interest, and elicited a discussion, in which Messrs. Chase, Pumphrey, Waller, Wilkinson, Marshall, and Bagnall took part.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—May 28th. Mr. J. Madison exhibited land and freshwater shells, collected at Weston-super-Mare; also specimens of *Pisidium amicum* from Hopwood; Mr. Hopkins, a collection of shells, made in

the Edge Hill district; Mr. J. Collins, a collection of plants from Bewdley, including *Lathræa squamaria*, parasitic on a poplar, and *Saxifraga granulata*. Under the microscopes, Mr. J. Madison, palate and upper jaw of *Helix pomatia*; Mr. Corbet, circulation in a stickle-back.—June 4th. Mr. J. Madison exhibited a specimen of *Limax agrestis* var. *albida*; Mr. Deakin, a collection of shells from Gloucestershire, including specimens of *Bulinus montanus* and *Clausilia Rolphii*. Under the microscope, Mr. Moore, *Anguillula aceti*, the vinegar eel. Mr. Dunn showed a nodule of flint of which a fossil echinus was the nucleus.—June 11th. Mr. Corbet showed slabs of Keuper marlstone, from Adderley Park Road, with ripple marks and pseudo-morphs of salt crystals; Mr. J. Madison, a curiously distorted specimen of *Planorbis spirorbis*. Mr. Rodgers, under the microscope, *Pandorina morum*. Mr. J. W. Neville then read a paper on “Drawing Microscopic Objects.” The writer said all who worked with the microscope found out the necessity of making drawings of some objects they examined, if any permanent records of them were to be kept. This necessity increased exactly as the facilities for preserving objects diminished. In illustrating any subject connected with microscopy, the real objects should be shown where practicable; when they could not, drawings must do duty for them. The writer glanced at the different kingdoms of nature, and showed where drawings were of little use and where important, and remarked that we were largely indebted to the draughtsman for our knowledge of “pond life.” The slight but carefully executed drawings, issued by the late Mr. Thomas Bolton, would be familiar to all as models of accuracy and care. The various appliances for drawing objects were reviewed at length, and preference given to Beale’s Neutral Tint as being simple in form, economical in price, and easy to use. The process of drawing objects was shown, and a few hints on the preparation of magic-lantern slides given. The paper was illustrated by a large number of drawings.

DUDLEY AND MIDLAND GEOLOGICAL SOCIETY AND FIELD CLUB.—The Annual Meeting of this Society was held in the Museum, Dudley, on the 16th May, the president, Mr. Horace Pearce, F.L.S., F.G.S., in the chair. The yearly report of the committee and statement of accounts were presented and adopted, and the officers for the present year elected; Mr. H. Pearce being re-elected as president. After the conclusion of business, the party visited the Earl of Dudley’s openwork at Claycroft, near Tipton, where a fine exposure of the South Staffordshire thick coal, which here attains the extraordinary thickness of fourteen yards, has been stripped of the overlying few feet of earth and rubble, and is being quarried in open daylight. This fine seam of coal, so close to the surface, was worked at an early age of mining by most primitive means, the miners sinking shallow pits and hollowing out the coal round the bottom as far as they ventured to go, having no means of clearing the pits from the water which percolated through from the surface. These old pits are locally termed “bell-pits” from their shape, and may be seen, filled up with surface rubbish, along the line of outcrop of the coal measures and at Claycroft. The party then proceeded to Coseley to examine a bed of ironstone lying a few feet above the thick coal, and the nodules of which contain remains of ferns, insects, crustaceans, &c., in an excellent state of preservation. Mr. Madeley exhibited from this bed a fine collection of ferns, including *Alethopteris louchitica*, *Neuropteris gigantea*, *N. heterophylla*, together with large specimens of *Cyclopteris tricomanoides*, which is now generally considered to be part

of *N. heterophylla*. Mr. Madeley also exhibited some fine wings of neuropterous insects, *Brodia priscotiucta*, which retain the patches of colouring that their wings displayed in life; also specimens of a large spined myriapod, *Euphoberia ferox*, and three species of Limuli, viz.:—*Bellinurus bellulus*, *B. Kenigianus*, and *Prestwichia rotundata*. The Society held their second Field Meeting on Tuesday, the 12th June, at Pontesbury, near Shrewsbury, for the purpose of examining the Uriconian (Archæan) rhyolites of that neighbourhood, discovered and described by Dr. Callaway. Alighting at Plealey Road Station, the party first examined the exposures of these devitrified lavas on the north flank of Pontesford Hill, and then walked to Lyd's Hole, a pretty little glen with cascade, where good specimens of rhyolite containing specks of chalcedony and showing the lava-flow were obtained. Just above the waterfall a band of the rock was found which showed a spherulitic structure, as described by Dr. Callaway in the "Quarterly Journal of the Geological Society" for May, 1882. Lower down the brook was found a bed of Lower Caradoc shale, which was pointed out by the same observer, from which were obtained *Asaphus Powisii*, *Trinucleus concentricus*, *Orthis testudinaria*, and *Diplograptus pristis*. The following plants were determined by Dr. Fraser, viz.:—*Geranium lucidum*, *G. dissectum*, *Cotyledon umbilicus*, *Sedum telephium*, *S. Fosterianum*, *Teesdalia nudicaulis*, *Cynoglossum officinale*, *Linaria cymbalaria*, *Poa nemoralis*, *Asplenium adiantum nigrum*, *A. trichomanes*, *Polystichum angulare*. The following freshwater and land shells were collected by Mr. Morgan (Welshpool):—*Limnea peregra*, *Planorbis albus*, *P. nautilus*, *P. nitidus*, *Ancylus lacustris*, *A. fluviatilis*, *Pisidium pusillum*, *Helix rotundata*, *Zonites crystallinus*, *Limax agrestis*.—An afternoon Field Meeting was held on Saturday, the 23rd inst., at Walsall, to examine the Llandoverly sandstone and Woolhope (Barr) limestone in that neighbourhood. The members first drove to see the Wenlock shale, which is to be seen close by the canal on the Birmingham Road, where *Heliolites Grayi*, a coral peculiar to this shale was found, together with *Eucrinurus punctatus*, and other fossils. The drive was then resumed to a small exposure of Llandoverly sandstone, the oldest rock to be found in South Staffordshire, some parts of which are highly fossiliferous, yielding several species of *Pentamerus*, and also *Strophomena*, *Petraia*, *Eucrinurus*, *Ptilodictya*, &c., but as the rock is a coarse grit, only the casts are preserved, and they are very fragile. Mr. Symons (Walsall) exhibited a good collection of fossils from this bed obtained by his own hammer. The party then went to the old quarries of Woolhope (Barr) limestone, and noticed the concretionary layers of limestone alternating with soft shale, but were not successful in finding more than a few small brachiopoda. The botanists found a few interesting limestone plants on the banks. The Society will hold the following Field Meetings during the season:—July 4th and 5th, Northampton, Annual Meeting of Midland Union of Natural History Societies; July 23rd, Bredon Hill; August 22nd, Brown Clee Hill or Ankerdine; September 18th, Rock near Bewdley.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.
—SECTION D, ZOOLOGY AND BOTANY.—Chairman, F. T. Mott, F.R.G.S. Evening Meeting, Wednesday, June 20th; attendance, eight. The chairman reported that the excursion last week to Swithland Wood was attended by six members. It was wet and little was done, but in the wood a moss new to the county was collected (*Brachythecium salebrosum*). *Cotyledon umbilicus* was found in flower, and large banks

of wild strawberries. The party were handsomely entertained on their way home by Rev. T. A. Preston, at Thurcaston Rectory. The oaks in the wood were much devoured by the caterpillar of the Oak Egger. Exhibits: Specimen of *Brachythecium salebrosum*, by the chairman; curious branched frond of the *Ceterach* fern, by Mr. G. C. Turner; leaves of the variegated Negundo maple, by Mr. Headley. Mr. Knowles reported that damson trees were much damaged in their foliage this year, apparently by the high winds. Dr. Finch confirmed this. A short discussion took place on the question, "What causes the Caterpillar to change into a Butterfly?" The chairman pointed out that, though there might be no greater difficulty in this question than in many similar ones in the science of biology, yet this was a peculiar case, because the caterpillar was a complete living animal, which without any external cause went to sleep, and by an extraordinary change in its muscles, mouth, limbs, skin, and clothing, woke up an entirely different creature. Where, in the caterpillar, was the *plan* of the butterfly, and the power to produce it?

SEVERN VALLEY NATURALISTS' FIELD CLUB.—The first Field Meeting of the season 1888 took place at the Wrekin, and was attended by between forty and fifty members. At the large quarry at the foot of the Wrekin, Dr. Callaway gave a brief sketch of the progress of discovery in the district, referring first to Mr. Allport's determination of the true nature of the igneous rocks of the Wrekin. The bedding of the rock in the quarry was pointed out, and its structure as a normal felspathic ash was shown on hand specimens. The steps of further investigation from the discovery of the Cambrian age of the Shineton shales, with the underlying Hollybush sandstone, and the still older Quartzite, resting discordantly upon the volcanic series, led to the conclusion that the last-named was of pre-Cambrian (Archæan) age. To this great volcanic group the name "Uriconian" (from the Wrekin) was given. The great antiquity of the Uriconian rocks was further confirmed by the fact that the conglomerates and grits of the Longmynd, which were at least as old as Lower Cambrian, were largely derived from them. Evidence of a still more ancient formation was supplied by the Uriconian conglomerates of the district. In these were found rounded pebbles of many kinds of hypogene rock, such as were seen at Primrose Hill and the Ercal. These were the true "Bottom Rocks." They were similar to the Crystalline rocks of Malvern (Malvernian), and to the gneisses which went by the names of "Hebridean" and "Laurentian." At the summit of the Wrekin the lavas (Rhyolites) of the Uriconian series were pointed out, and the general geology of the district was described. Many of the readers of the "Midland Naturalist" are already familiar with Dr. Callaway's discoveries from the Journal of the Geological Society of London. After ascending to the summit and returning *viâ* the cottage, carriages, kindly sent by Dr. Cranage, of the New Hall, were in waiting, and conveyed the party to his residence, where a most sumptuous dinner was provided. The secretary, the Rev. R. C. Wanstall, R.D., Vicar of Condover, proposed fourteen new members, and on the proposition of the Rev. H. J. Ward, Vicar of Morville, seconded by Mr. Homfray, and warmly supported by the hon. secretary, Dr. Callaway was elected president of the Club. The learned doctor, in accepting the office, said his aim and object would be to assist the members in the investigation of science.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

ELEVENTH ANNUAL MEETING, NORTHAMPTON,
JULY 4TH AND 5TH.

The Eleventh Annual Meeting of the Midland Union, which was held at Northampton, on the 4th and 5th July, will be remembered, by those who were fortunate enough to be present, as one of great interest and enjoyment. The arrangements which the Northamptonshire Natural History Society and Field Club had made for the comfort and convenience of the visitors were excellently carried out, the hospitality so courteously extended was appreciated to the full, and altogether the Meeting was quite a successful one. The Northampton Society had arranged for the holding of the Soirée and one of the Excursions in conjunction with the Annual Meeting of the Northamptonshire Architectural Society, and this gave the members of the Midland Union unusual facilities for the study of the fine churches visited on the 5th.

Delegates were present from the following Societies:—Birmingham Natural History and Microscopical Society, Birmingham Philosophical Society, Birmingham and Midland Institute Scientific Society, Northamptonshire Natural History Society and Field Club, Oswestry and Welshpool Naturalists' Field Club, Oxfordshire Natural History Society and Field Club, Rugby School Natural History Society, Tamworth Natural History, Geological, and Antiquarian Society.

The principal business of the Council, over which the Rev. S. J. W. Sanders, D.D., presided, was to receive the report of the adjudicators for the Darwin Medal, and to determine on the award. The Report to the Annual Meeting was discussed and adopted, and a general discussion on the affairs of the Union took place.

The General Annual Meeting was held in the Old Museum Room, under the presidency of the Rt. Hon. Earl Spencer, K.G., who, in welcoming the Union to Northampton, gave an interesting address on the value of a general and intelligent study of Natural History as an addition to the enjoyment and interest of every-day life. In some later remarks he deplored the reckless killing of our native birds, instancing the Heronry at Althorp, and his constant fear lest the Herons should leave the place or be completely exterminated.

The Rev. H. H. Slater, of the British Ornithologists' Union, delivered an address on "Insularity," which will be published in a subsequent issue of the "Midland Naturalist."

The Report from the Council announced that the Darwin Medal had been awarded to Mr. J. E. Bagnall, A.L.S., for his paper on the "Flora of Warwickshire," which all readers of the "Midland Naturalist" will remember as appearing from time to time in its pages.

Mr. Bagnall was unfortunately not able to be present, so that the Medal was received on his behalf by Mr. W. R. Hughes. The Report, which is appended, will show the high estimate which the adjudicators formed of Mr. Bagnall's work.

The Treasurer's Report showed a satisfactory state of the finances of the Union, there being an *estimated* balance in hand, some accounts not having yet been paid, of about £16.

It was reported that no invitation had been received for the Meeting in 1889, so that the matter was left in the hands of the Executive Committee.

Votes of thanks were passed to the Officers for the past year; to the Northampton Society for the excellent preparations for the Meeting; and to the Chairman. The Editors of the "Midland Naturalist" were re-elected, as also the Treasurer and Secretary.

The *Conversazione* in the Town Hall was very interesting, although the attendance was not so large as had been hoped for, a fact which was probably largely due to the very stormy weather.

Papers were read during the evening by Mr. H. M. J. Underhill, of Oxford, on the "Eyes of Insects," and by Mr. Beeby Thompson on the "Jurensis Zone of Northamptonshire." At the same time the Architectural Society held its annual meeting, at which several papers of great archaeological interest were read.

The whole of the arrangements were carried out in an admirable manner by the local Societies, and those who were present expressed their great pleasure at both the collections and the papers.

The Excursions on the 5th of July were carried out according to the programme, with the exception of the Geological one, which did not take place.

The Botanical Excursion resulted in the discovery of a new Moss, *Leucobryum glaucum*, and a red variety of *Usnea barbata* was obtained.

Those who joined the Archaeological Excursion had the opportunity of inspecting the very interesting churches at Higham Ferrers, and Rushden, with the quaint parvise over the north porch in which, within living memory, an old woman used to live, having to ascend to her room by a ladder;

Irchester, Castle Ashby, and Earl's Barton, the latter being a fine example of an Anglo-Saxon church.

The weather, fortunately, interfered with the Excursions less than might have been feared, and the visitors brought away very pleasant memories of the kindness and forethought which had made the Eleventh Meeting of the Union so successful and enjoyable.

THE REPORT OF THE COUNCIL.

SOCIETIES COMPOSING THE UNION.

During the past year the Oxfordshire Natural History Society and Field Club has entered the Union.

The Council, however, regrets that the Evesham Field Naturalists' Club is reported to be abandoned, and that no communications have been received as to the Nottingham Working Men's Naturalists' Society either last year or this, so that we must remove that from our list which will now stand as follows, the Peterborough Natural History and Scientific Society having also left the Union in accordance with the notice received last year:—

Birmingham Microscopists' and Naturalists' Union.

Birmingham Natural History and Microscopical Society.

Birmingham Philosophical Society.

Birmingham and Midland Institute Scientific Society.

Birmingham School Natural History Society.

Caradoc Field Club.

Dudley and Midland Geological and Scientific Society and Field Club.

Leicester Literary and Philosophical Society.

Malvern Field Club.

Northamptonshire Natural History Society and Field Club.

Oswestry and Welshpool Naturalists' Field Club.

Oxfordshire Natural History Society and Field Club.

Rugby School Natural History Society.

Severn Valley Naturalists' Field Club.

Tamworth Natural History, Geological, and Antiquarian Society.

DARWIN MEDAL.

The subject for which the Darwin Medal is awarded this year is Botany, and the papers which have appeared in the "Midland Naturalist," and were eligible for the competition, were submitted to the following gentlemen who kindly acted as adjudicators, viz.:—Professor I. Bayley Balfour, F.R.S.; Maxwell T. Masters, M.D., F.R.S.; Spencer Le Marchant Moore, Esq.; William Mathews, M.A.; and Professor W. Hillhouse, M.A., F.L.S.; the services of the last named being made possible by the fact that, in deference to his strongly expressed desire, the Committee reluctantly consented to withdraw a paper, contributed by him, from the list to be submitted to the adjudicators.

The Reports received from the Adjudicators were unanimous in speaking very highly of Mr. J. E. Bagnall's paper on the "Flora of Warwickshire," such expressions being used as "a solid contribution to scientific knowledge," "preeminently the kind of investigation which the Darwin Medal was instituted for the purpose of encouraging, and they alone are sufficient justification for the existence of the

Medal." "Evinced great industry in an important, although, at the present time, somewhat unpopular branch of the Science." But one of the five did not consider that the work came under the head of "original work," and so did not venture to recommend the award of the Medal.

In accordance with the opinions received the Council has awarded the Darwin Medal for this year to Mr. J. E. Bagnall, A.L.S., for his "Flora of Warwickshire," and various other papers bearing on parts of the same subject.

"MIDLAND NATURALIST."

The "Midland Naturalist" has been published regularly, and the papers which have appeared in it have been of great interest and value.

Some of the principal papers are as follows:—

On the Measurement of the Magnifying Power of Microscope Objectives, and a Note on the Recent Riviera Earthquake, by W. P. Marshall, M.I.C.E.; Colour Reaction, with special reference to Botanical and Microscopical Investigations, by W. H. Wilkinson; Passages from Popular Lectures, by F. T. Mott, F.R.G.S.; Volition, by Constance C. W. Naden; Botanical Notes and Conchological Notes from South Beds, by Jas. Saunders; Notes on a New Zealand Rock, and on the Dust Ejected in the Eruption of Tarawera in June, 1886, and a Note on the Occurrence of Gold at Mount Morgan, in Queensland, by Thomas H. Waller, B.A., B.Sc.; Notes on the Valley of the Warwickshire Stour and its Flora, and a New British Moss, by J. E. Bagnall, A.L.S.; The Discomycetes of the Birmingham District, by W. B. Grove, B.A.; The Fungi of Warwickshire, by W. B. Grove, and J. E. Bagnall; The Recent Landslip at Zug, by William Pumphrey; On some Aids rendered by Photography to Geology, by W. J. Harrison, F.G.S.; Some Investigations into the Function of Tannin in the Vegetable Kingdom, by Professor W. Hillhouse, M.A., F.L.S.; Individualism in Art, by W. K. Parkes; The Present and Future of Science Teaching in England, by Professor W. Hillhouse, being his retiring address as President of the Birmingham Natural History and Microscopical Society; Notes on the Climate of South Queensland, by Clement L. Wragge, the Government Meteorologist of Queensland, to whose labours the "Midland Naturalist" was for some years indebted for Meteorological Notes; William Mathews, M.A., has been publishing a History of the County Botany of Worcester, and B. Thompson, F.C.S., F.G.S., has continued his paper on the Water Supply from the Middle Lias of Northamptonshire.

At the last Annual Meeting the Council adopted a resolution appealing to the various Societies of the Union for more support for the "Midland Naturalist" in the way both of getting more subscribers, and also in the furnishing of papers. They believed that, even for those Societies which publish their own transactions separately, abstracts of papers read and notes of observations recorded would, in many cases, be of great value if published in the "Midland Naturalist," and would increase the general interest in the Union among the members, as well as facilitate their studies.

The Societies composing the Union differ considerably in character. Some of them are Field Clubs only, or, at any rate, the meetings for the reading and discussion of papers and exhibition of specimens are quite subordinate to the excursions, although at these explanatory papers are frequent. Others have meetings for papers and exhibitions, but have no published record of them. Two of the Birmingham Societies give abstracts and reports of their meetings in the "Naturalist," while the Birmingham Natural History and Microscopical Society use

the Journal for the publication of their entire proceedings, and provide a copy for each member monthly. Hence, the list of papers previously given really serves as a report of the transactions of the Birmingham Natural History Society and but little more. The Council again urges upon the component Societies, especially those which do not publish separate transactions, at whose meetings nevertheless there must be a considerable amount of original matter produced, to make more use of the means which the "Midland Naturalist" provides for publication in such a simple yet efficient manner.

In the transactions of the Societies which publish separately we may mention, from the Transactions of the Leicester Literary and Philosophical Society—A Paper on the Roman Pavement in Jewry Wall Street, Leicester, by William Jackson; The Aylestone Sandpit in the Soar Valley, by C. A. Moore, M.D.; The Songs of some Leicestershire Birds, by F. T. Mott, F.R.G.S.; A Note on the Grained Structure of Matter, by Rev. E. Atkins, B.Sc.; The Cause and Limit of Organic Growth, by F. T. Mott, F.R.G.S.; A Catalogue of Leicestershire Land and Fresh Water Mollusca, by H. E. Quilter, M.C.S.; The Poetic Drama of the present Reign, by the President, A. H. Paget with a few more literary papers.

The Birmingham Philosophical Society, in its published Proceedings, states that the Endowment of Research Fund, which it had the honour of initiating, still continues to be useful for the purpose for which it was instituted. Grants have been made in aid of researches on the Hardness of Metals, the Erratic Blocks round Codsall, and the Study of the Bacteria, as well as general chemical research by Dr. Gore. Reports on these matters have been presented to the Society, and have proved the value of the assistance which the fund has rendered.

Among the important papers contained in the last published volume of Proceedings may be mentioned:—Professor Windle on the Myology of Hapale Jacchus; Thomas Turner, F.C.S., on the Hardness of Metals, and on Silicon in Iron and Steel; Professor J. H. Poynting on the Electric Current; Professor Poynting and E. F. J. Love on the Law of the Propagation of Light. Dr. Gore on the Electrolysis of Alcoholic and Ethereal Solutions of Metallic Salts, on the Effect of Heat on Fluoride of Cerium, and on Transfer Resistance.

An important step has also been taken by this Society in the formation of special sections for the study of the various branches of Natural History. Not much more than a beginning has yet been made in this direction, but the rule which has been adopted by which persons not members of the Society can become members of the section, on payment of a quite small fee, is calculated to make the sections available as centres round which may gather the special workers in the various subjects in a manner scarcely possible for the more miscellaneous general Societies.

The Journal of the Northamptonshire Natural History Society and Field Club contains many important papers on Natural History. Among them a part of the Flora of Northamptonshire, by G. C. Druce, F.L.S.; Notes on the Birds of Northamptonshire, by Lord Lilford, F.L.S.; Notes on the Polyzoa, &c., from the Gayton Boring, by G. R. Vine; a Deep Boring at Bletchley, by H. J. Eunson, F.G.S.; Northamptonshire Mosses, by H. N. Dixon, F.L.S.; Notes on the Migrations of Birds, by Rev. H. H. Slater, F.Z.S.; Pre-historic Man in Northamptonshire, by T. J. George, F.G.S.; Meteorological Notes, by H. Terry.

This Society has also a photographic section, and the Journal is illustrated with occasional photographs—such as one of a monumental bust of Wm. Smith, the father of English geology, and of the peculiar tower of Irthlingborough Church.

The work of the more specially Field Clubs in the Union, although not so capable of report, seems to have been well maintained during the past year. At many of the Field Meetings papers illustrative of some of the special features to be observed are read, and the parties have the advantage of the ready help of the more experienced members as well as, frequently, of that of the naturalists of the district visited.

We think it is evident, from the account given above of the work which is being done by our Societies, that there is a good deal of scientific energy which the Union ought to be able to make more generally useful. We have a certain amount of organization which might be made the means of much more communication among the Societies than is at present maintained. But, of course, in this matter the Union must take its character from the Societies which compose it. If the desire for interchange of papers, &c., is felt, the way to carry out the plan will be easy; on the other hand, if there is no desire for such interchange, the Union cannot hope for any success in the attempt.

A CHAPTER IN THE PHYSICAL GEOGRAPHY OF THE PAST.

PRESIDENTIAL ADDRESS
GIVEN TO THE BURTON-ON-TRENT NATURAL HISTORY
AND ARCHÆOLOGICAL SOCIETY.*

BY HORACE T. BROWN, F.G.S., F.I.C., F.C.S.

The first aim of a local Society like ours should be to make a careful and accurate record of all the natural phenomena of our neighbourhood; but, were we content with this alone, we should scarcely be entitled to consider ourselves a *scientific* body. Science does not consist in the mere accumulation of facts, for no matter how interesting these may be in themselves, we must remember that after all they are only a means to an end. Facts *belong* to science, it is true, but we must look upon them merely as the raw material out of which we elaborate, by processes of scientific reasoning, great principles of universal application.

I sometimes hear it asked whether the lists of the district fauna and flora, which are so carefully compiled by many hard working members of our local societies, have any value, apart from that of an index to the student of the exact locality where he may expect to find any particular plant or insect which he may be studying. Now, undoubtedly, the immediate value of such lists is the one I have indicated,

* Delivered November 4th, 1887.

but they have a far greater importance than this in affording material to the philosophical naturalist for studying geographical distribution, and for working out all those great influences of climate, soil, and general external conditions, upon the varietal changes which occasionally become stereotyped as new species. In order to facilitate this highest aim of the naturalist our local societies ought, I think, to make their lists more *quantitative* in character, if that is possible, and to note more than they do at present the inter-dependence of animal and vegetable life, and the relations of the plants to the geological nature of the soil upon which they are found. The field geologist often gets valuable hints as to the character of the rocks hidden under a thick mantle of vegetation by observing the nature of the plants growing upon them. Plenty of instances of this kind must occur to any geologist who has occupied himself with the minute survey of a district. As a good example, I may mention that Professor A. H. Green, during his survey of the Carboniferous Rocks of North Derbyshire, found that he was often able to define the boundary of the Carboniferous Shales and Sandstones by the fact that rushes are found on the shales, and that heath and furze grow more plentifully on the sandstones; and he also notes that a crowded belt of the little *Viola lutea* is often seen along the outcrop of a sandstone bed, whilst not a single plant will be found on the shales that come out on either side.

The aid which botany is able to afford to geology is manifestly reciprocal, and if botanists would only take care to note, amongst other things, the kind of sub-soil upon which any particular plant grows, they would, I think, render their lists more valuable and attach to them a far wider interest than they commonly possess.

These are mere suggestions which I venture to make for your consideration, but I will not enlarge upon them this evening, as I wish to occupy your time in trying to deduce from a mass of geological facts, which to many of you must seem dry and uninteresting, certain generalisations which, I trust, will prove of interest even to those who have no special knowledge of geology.

The student of geology, whilst occupied in observing the thickness of strata, their physical nature, order of superposition, angles of dip, and fossil contents, finds, it is true, a keen and vivid enjoyment in such work, but if he is of a philosophical turn of mind he will place but little scientific value upon such observations when they are regarded as mere isolated phenomena; but when a large mass of facts has

been accumulated and systematized, it becomes possible, by a comparison and correlation of results, and by the application of strict methods of reasoning, to make out the order of past events, and to read by the light of the present the physical changes which this world of ours has undergone in ages long past. This is, indeed, the highest aim of geology, which has been well defined as the "physical geography of the past," and, I think, I shall do well by attempting to show you something of the methods by which this reconstruction of old-world features is accomplished, and by applying them to the elucidation of some of the past conditions of the portion of central England in which we live. The period which I have selected for this purpose is that in which were laid down the great mass of the Carboniferous Rocks—rocks including the Mountain Limestone and the Coal Measures. Owing to their vast superficial exposure in Great Britain and Ireland, and to the manner in which they have been explored for their mineral wealth, we have, perhaps, in the Carboniferous Rocks, a greater accumulation of important facts to work upon than we have in any other system.

Before attempting to throw any light upon this chapter in the ancient physiography of our Midland district, I must, in the first place, call your attention to the existing conformation of the surface, and to the close connection there is between the nature of the underground rocks and the features of the country as now presented to us.

If we look at any good physical map of England we notice, running almost down the centre of the Northern part of the country, a broad range of hills, which forms a great water-parting, from the western side of which the streams run into the Irish Sea, and from the eastern into the North Sea. This broad ridge of high ground, one of the most striking natural features of our country, is known as the Pennine Range, and has been aptly described as the *backbone* of England. It attains its highest elevation of about 2,600 feet in the North Riding of Yorkshire, and in the Peak, the highest part of North Derbyshire, it reaches about 2,000 feet above the sea level. When followed from the northern counties southward this ridge of high land is found to terminate abruptly a few miles to the west of Ashbourne, in the Weaver Hills, and it is this southern portion of the range which serves to illustrate in the best possible way the geological structure of the Pennine Chain.

The rocks constituting the Chain belong exclusively to the Carboniferous System, that great division of the older rocks which, in its upper part, contains all the principal coal seams

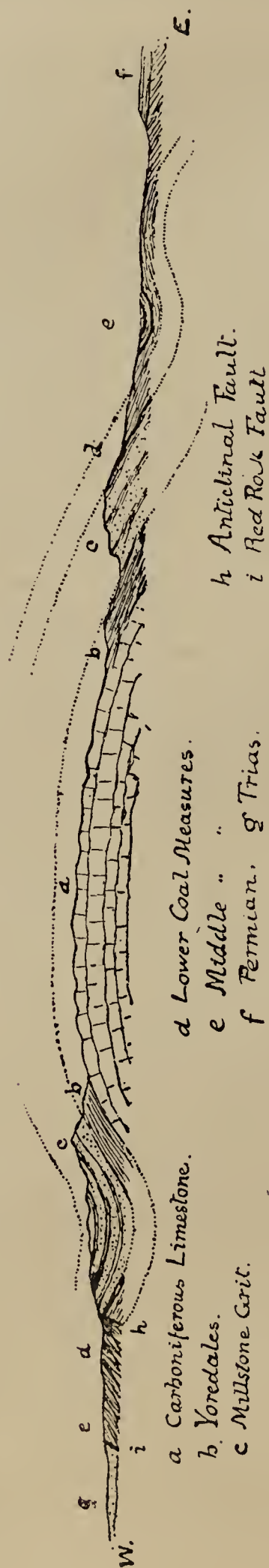
of this country. This division, or *system*, as geologists call it, can be broadly divided into four series of strata which are invariably found in the same vertical order or succession. The lowest series is that of the *Mountain Limestone*, a mass of hard, and in some cases almost crystalline, Limestone rock. Above the Mountain Limestone we have a series of black shales and sandstones, with thin beds of impure limestone, known as the *Yoredale Shales*; and above the Yoredale Shales we have the *Millstone Grit*, a mass of coarse sandstones with thick shale partings, and an occasional thin seam of impure coal. The Millstone Grit is in turn overlaid by the Upper, Middle, and Lower Coal Measures, which are made up of an assemblage of sandstones and shales, with many important and excellent beds of workable coal in their middle division.

| | | | | |
|---------------------|---|---------------------|---|---------|
| Upper Carboniferous | { | Coal Measures | { | Upper. |
| | | | | Middle. |
| | | | | Lower. |
| | { | Millstone Grit. | | |
| Lower Carboniferous | { | Yoredale Shales. | | |
| | | Mountain Limestone. | | |

The exact line drawn between these various members of the Carboniferous System is, for the most part, an arbitrary one, for although, when looked at as a whole, each division has very different characters from the one below and above it, yet they often pass into each other vertically by insensible gradations.

The total thickness of this great pile of strata is probably over 12,000 feet in Derbyshire, and this does not represent the whole of the original thickness of the beds. From the evidently *sedimentary* character of all these rocks we are quite sure that the materials were laid down under water in a horizontal, or almost horizontal, position, but we now find them elevated considerably above the level of the sea, and with their original bedding lines inclined to the horizon at all sorts of angles. The true relation of such beds to each other, and to the present conformation of the surface, can only be ascertained when a large district has been surveyed, and all the outcrops of the strata laid down on a map with the observed inclinations or *dip* of the strata, as it is called. From such maps it is possible to construct imaginary sections across a country, showing at a glance the present position of strata, which, once forming horizontal and continuous sheets, may now have become folded, faulted, and disconnected in all sorts of complicated ways.

You have before you such a horizontal section, taken along an east and west line across the Pennine Range, from



about eight miles north-east of Chesterfield, through Buxton to Macclesfield, a total distance of about thirty-five miles. This section must be considered as diagrammatic, for besides having its vertical scale much exaggerated, it has been somewhat generalised so as to bring into prominence the salient points bearing upon the structure of the Range.

You will observe that the rocks, which, as I have said before, were originally laid down in a horizontal position, are now thrown into a huge *fold* or *arch*, with one or two minor folds or corrugations flanking it.

The direction of the folding is approximately north and south, and looked at in a general way the strata incline from the centre of the arch both to the east and to the west, just as the slanting sides of a roof do from the ridge tile. As we travel from the central mass of limestone of North Derbyshire in either of these directions we pass successively, and in ascending order, over the edges of all the divisions of the Carboniferous System right up to the Coal Measures. A study of the map and section would strongly suggest to us that the strata which are now thus severed were once continuous right across the arch, and this is put beyond doubt, not only by the similarity of the sedimentary strata on either side, but also by the proved identity, a little further north, of several of the Coal Seams in the Lancashire and South Yorkshire Coalfields, which lie on opposite sides of the great fold. The crown of the arch or *anticlinal* has, in the district we are considering, been so far destroyed since its elevation, by the ceaseless action of rain and river, frost and snow, aided to some extent by the sea, that the great mass of Coal Measures, Millstone Grit, and Yoredales, which once stretched right across from side to side, has been completely swept away, exposing to the light of day the Mountain Limestone; so that this, the lowest member of the Carboniferous Series, now occupies the most elevated part of the ridge.

(*To be continued.*)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

EDWIN LEES IN HAST. "ILL. NAT. HIS. WORC., *continued.*"

(*Continued from page 185.*)

- * *Hyoscyamus niger*, 156. Side of the road beyond Spetchley, but most abundantly near Little Malvern, at the base of the Herefordshire Beacon. *The last named locality is possibly in Herefordshire.* L.M.

- * *Verbascum Thapsus*, 156. Abundant about the Malvern Hills, and by the road sides in neglected spots. L.M.
- * *V. Lychnitis*, 156. Near Malvern.
- * *V. virgatum*, 156. Formerly found by the side of the Kidderminster Road at Bevere, near Worcester, where it was first noticed by Dr. Stokes. It has been gathered in the same habitat so late as 1829, but has now disappeared. S.G.
- * *V. Blattaria*, 156. In the vicinity of Malvern. S.G. L.M.
- * *Digitalis purpurea*, 169. In immense quantities about the Malvern and Abberley Hills, and scattered in various other places. L.M.
- * *Antirrhinum majus*, 169. Walls about the Commandery, Cathedral, and Bishop's Palace. S.G. L.M.
- * *A. Orontium*, 169. Cotheridge. Mr. Walcot. Kempsey. Dr. Streeten.
- * *A. (Linaria) Cymbalaria*, 169. On the old city walls, Worcester; and the south side of the Abbey Church, Great Malvern; but a garden straggler. S.G.
- * *Veronica montana*, 149. Described by Purton as "very rare." Wood at the west end of Powick Ham, near Worcester; Dr. Stokes; where it has since been found by Dr. Streeten, but Mr. France having recently built upon this spot, and made alterations in the ground, the plant has disappeared. In a wood nearer to Malvern. Mr. Lees. By the side of a stream in a place called "the Gullet," between the Swinnet and Hollybush Hills, in the Malvern Range, southward of Little Malvern. Messrs. Morris and Lees, 1834. *The Gullet is about 1 mile south of the Herefordshire Beacon, and the locality probably in Herefordshire.* S.G. *V. montana is not uncommon about Malvern and in the upland woods in the northern part of the county of Worcester.*
- * *V. scutellata*, 149. Bogs on the Malvern Hills, especially at the western base of the Worcestershire Beacon. Rare. S.G.
- * *V. Anagallis*, 149. Pools near Powick on the Malvern Road. Ashmore Common. Near Pershore. Duck Brook, near Worcester. S.G.
- * *Pedicularis palustris*, 169. Rather uncommon. In the boggy marsh at Wyre, near Pershore.
- * *Lathræa squamaria*, 169. Growing in some abundance under a white poplar tree by the side of the brook below Bridgestone Mill, Alfrick. Mr. Lees. Also above the bridge, near the Mill. At Great Malvern, under an elm by the side of the road near the turnpike. Mr. Addison. S.G. L.M.
- * *Orobanche major*, 169. In Shrawley Wood, by the pool; at Abberley, on the acclivity above the Hundred House; and between Suckley and Bear's Wood.
- * *Verbena officinalis*, 168. Near Farm Houses at Barnard's Green, Powick, &c.
- Mentha sylvestris*, 168. By the side of a rill beyond the yew tree on the Ombersley Road, Worcester.
- * *M. piperita*, 168. By the side of a rill at Malvern Link, and in other wet spots about the Malvern Range. L.M.
- M. rubra*, 168. By a pool near the firs, at Clifton-on-Teme.

- Origanum vulgare*, 168. Side of the road at the foot of Craycombe Hill, near Evesham. Also at the top of Southstone's Rock, and at Lower Sapey. Mr. Lees.
- * *Thymus Calamintha* (*C. menthifolia*), 168. About Malvern, Grimley, &c., by road sides. L.M.
- * *Nepeta Cataria*, 168. Lane beyond the Gas Works, Worcester, and in other similar situations. L.M.
- * *Salvia Verbenaca*, 150. On the bank by the road side, at Red Hill, near Worcester. S.G.
- * *Scutellaria galericulata*, 168. In marshy spots by the side of the Severn. Kempsey Brook.
- * *Marrubium vulgare*, 168. At Astley, and Clifton-on-Teme.
- Lamium maculatum*, 168. Found near Defford Common, by Dr. Streeten.
- * *Galeobdolon luteum*, 168. In Berwick's Shrubberies, and various shady woods at Powick, Kempsey, Alfrick, Clifton, &c.
- * *Echium vulgare*, 154. Not uncommon in the northern part of the county, but almost unknown in the southern. On the walls of Dudley Castle.
- * *Lithospermum officinale*, 154. Battenhall, near Worcester, and on the lime rubbish about the western base of the Malvern Hills. S.G. L.M.
- * *Myosotis cæspitosa*, 153. Ditch in the Severn Meadows, Kempsey. Dr. Streeten. L.M.
- M. arvensis*, 153. Sandy bank between Hagley and Stourport.
- * *M. versicolor*, 153. On the summit of the North Hill, Malvern. Ankerdine Hill.
- * *Borago officinalis*, 154. Battenhall, near Worcester, and about Bromwich Farm. At Lower Wick. S.G.
- * *Anchusa sempervirens*, 154. Under an old elm tree beyond the old Waterworks. Very uncommon. S.G.
- † * *Cynoglossum sylvaticum*, 154. In Deerhurst Lane, close to the Lower Lode Ferry near Tewkesbury. Very rare. *This habitat is in Gloucester.* S.G. L.M.
- * *Pinguicula vulgaris*, 150. On the north-west side of the Malvern Hills, in the bog below the Worcestershire Beacon, but in no other part of the range. L.M.
- * *Hottonia palustris*, 155. Pool at Clifton-upon-Severn. Dr. Streeten. S.G.
- * *Primula elatior*, 154. Oxlip. About Leigh Sinton, Cradley, &c., in pastures on limestone. S.G. *This is not the true P. elatior, Jacq, but P. vulgaris, var. caulescens.*
- * *P. veris*, var., 154. "Black Cowslip" of Dr. Abbot. A singular dark flowered variety found in a field at Bromwich Farm, by Mr. Lees. S.G.
- * *Lysimachia vulgaris*, 155. By the side of the weir above Powick Bridge, and banks of the Teme above Bransford. Banks of the Severn below Pixham Ferry. Very rare in this county. S.G.
- * *Anagallis cærulea*, 155. Plentiful in a fallow field near the Trench Woods. Mr. Edmunds. A singular pale purple variety, found at Shrawley by Messrs. Walcot and Lees.
- * *A. tenella*, 155. Bogs on the Malvern Hills. L.M.

- * *Samolus Valerandi*, 156. In the rills at Battenhall, near Worcester, and on Defford Common.
- * *Plantago Coronopus*, 153. On the conglomerate rock near the Giant's Grave, Habberley, near Kidderminster. Mr. Lees.
- * *Rumex palustris*, 161. Side of the Chalybeate Spa at Malvern. L.M.
- * *Polygonum Bistorta*, 161. Meadow near the Spa, at Malvern. Mr. Edmunds. Also by the rill at Southstone's Rock; in a meadow at the top of Trimpley Green, near Kidderminster, and in a moist pasture at Wichenford. S.G. L.M.
- † *P. viviparum*, 162. On Rosebury conglomerate rock by the Teme, below Knightsford Bridge. Mr. Lees. L.M. *An error; see New Botanists' Guide, p. 203.*
- * *Daphne Mezereum*, 161. Eastham and Stanford. Rev. E. Whitehead.
- * *Aristolochia Clematitis*, 177. Springing up in great abundance at the back of the garden of the large house in Foregate Street, lately occupied by Mrs. Pennethorne, pulled down to make room for the new Courts, 1834.
- Euphorbia Lathyris*, 177. Crow's Nest Woods. Dr. Streeten.
- * *Parietaria officinalis*, 153. Old walls near the Cathedral. S.G.
- { *Ulmus campestris*, 157. In almost every hedge.
- * { *U. suberosa*, 157. Hedges near Hallow.
- { *U. glabra*, 157. At Hindlip.
- * *U. montana*, 157. About the base of the Malvern Hills, &c.
- Fagus Castanea* (*Castanea vulgaris*), 178. In Shrawley Wood, apparently wild.
- * *Populus alba*, 178. At Alfrick, and in the vicinity of several brooks.
- * *P. tremula*, 178. Nunnery Wood, Malvern, Clifton-on-Teme, &c., not very uncommon.
- * *Juniperus communis*, 178. Bear's Wood, Suckley. Cracombe Hill, &c. L.M. *Bear's Wood is in Herefordshire.*
- Typha angustifolia*, 177. In a small pond on the Moors, Worcester, and in the pool at Ham Castle. Mr. Lees.
- † *Sparganium natans*, 177. Muddy pools near Cotheridge. Mr. Walcot.
- Sparganium minimum*, Fr., is intended here, and is a true record, see "*Botany of Worcestershire*," p. 56, and Watson's "*Top. Bot.*," 2nd Ed., p. 428.
- * *Acorus Calamus*, 160. In the Avon near Pershore, but rare.
- Potamogeton natans*, 153. Pool at Wichenford, and ponds about Malvern.
- P. pusillus*, 153. Kempsey Ford.
- P. pectinatus*, 153. In a pond near the old Waterworks, Worcester.
- * *Triglochin palustre*, 161. Marshy spots about the Malvern Hills. L.M.
- * *Sagittaria sagittifolia*, 178. In the Avon, and its tributary streams.

- * *Butomus umbellatus*, 162. River Severn, below Kempsey Ford. Dr. Streeten. Abundant by the banks of the Avon, but rare near Worcester. It has, however, recently stolen into the Birmingham Canal. S.G.
- Hydrocharis Morsus-ranæ*, 178. In a pool by the side of the New Road, Worcester. Also in several other ponds near Powick and Kempsey.
- * *Orchis pyramidalis*, 175. On the edge of the wood near the Lime Kilns at the Croft Farm, Mathon; and abundantly in the meadows by the Spout Brook, at Eastham. Mr. Lees. L.M.
- * *O. (Gymnadenia) conopsea*, 176. Abundantly in the meadows at the northern end of the Malvern Range. L.M.
- * *O. (Habenaria) viridis*, 176. On Hill Top, Cotheridge. Mr. Walcot. Meadow near Cowleigh Park, Malvern (*Hereford*). In a wet meadow at the northern base of the Round Hill, Abberley, plentifully. Messrs. Lees and Edmunds. L.M.
- * *O. (Habenaria) bifolia*, 175. In various hilly woods at Powick, Abberley, Malvern, &c., but not in any great abundance. *Habenaria chlorantha*, Bab., is the plant probably intended here. L.M.
- * *Ophrys apifera*, 176. In great abundance at Leigh Sinton. In almost equal abundance on the travertine by the Spout Brook at Eastham. Mr. Lees. S.G. L.M.
- * *Neottia spiralis (Spiranthes autumnalis)*, 176. In Kempsey Grove. Dr. Streeten. On the Common near Hunter's Hall, Little Malvern, and on the mound of Crookbarrow, near Worcester. Mr. Lees. S.G. L.M.
- Listera (Neottia) Nidus Avis*, 176. In a coppice at Kempsey. Dr. Streeten.
- Epipactis latifolia*. In a place called the Dingle (*Ham Dingle*), at Pedmore, near Stourbridge, and in the deep shades of the Devil's Den, at Clifton-on-Teme. Mr. Lees.
- * *E. (Cephalanthera) ensifolia*, 177. On the top of Abberley Hill. Rev. T. Butt. In the deep retired glades of Bewdley Forest, between Mopson's Cross and the Sorb Tree. Messrs. Walcot and Lees. S.G.

ON THE SUCCESSFUL USE OF OIL TO CALM ROUGH SEAS.

BY W. P. MARSHALL, M.I.C.E.

(Concluded from page 174.)

The oil shells that have been used contain about three quarters of a gallon of oil, and they are fired from a mortar with a charge of eight ounces of pebble powder. The shell is simply an oil-flask, at the bottom of which is a recess for a special fuse, which consists of two small chambers, in which there is a projecting submarine fuse about an inch in length. The fuse is capped with a composition that renders it absolutely water-proof, and is so constructed as to secure its

ignition with unfailing certainty ; and the fuse is timed so that it bursts at the point required, just as the shell is touching the surface of the water ; the oil from each shell covers a very considerable area of surface. In a trial at Folkestone on 29th January, 1884, of these shells, which are the invention of Mr. Gordon of Dundee, about a dozen of them were fired at a range of from 450 to 500 yards. The effect was wonderful ; the raging waters were gradually allayed, and for a considerable space the sea was converted into a lake with a gentle swell, in which a ship or a boat could ride with perfect ease. The smallest seaport may, therefore, with an old mortar and a dozen or two of gallons of oil, make a temporary harbour of refuge whenever the necessity arises.

Another plan for protecting harbours in storms, that has been devised by Mr. John Shields, of Perth, is a submerged pipe, carried out several hundred feet from the pier, into which oil is pumped ; a lead pipe about $1\frac{1}{4}$ inch bore is used, and at distances of a hundred feet apart are fixed upright pipes eighteen inches high, in each of which is a conical valve opening outwards and protected from silt by a rose. In a trial of this plan at Folkestone harbour, a lifeboat was rowed out of the harbour, and lying off the pierhead, rolled a good deal, but did not get a splash while in the wide glassy strip of oil-covered waters that soon stretched away for half a mile or more, though to seaward of this glistening streak the waves were curling and breaking into foam. On the harbour-side the effects of the oil were noticeable far in-shore, and few white caps were to be seen ; the film, greatly attenuated as it must have been, and not more than 100 feet wide, acting apparently as an efficient breakwater.

The distance to which the protecting effect of the oil extends, and the efficiency of this protection at sea, is illustrated by the following case. A large trading steamer plying from New Orleans, encountered a terrible hurricane in the Caribbean Sea, in October, 1887, when the ship was disabled and became unmanageable, and lay in the trough of the sea in a dangerous position, and entirely at the mercy of the waves, which repeatedly broke over her. The captain, finding it impossible to keep the ship's head up, determined to have recourse to the oil experiment. He put four oil-bags on the windward side of the ship, when the oil acted like magic. The sea became smooth for at least twenty-five yards in that direction, and not a sea broke over her, while ahead and astern and to leeward the ocean was in a wild rage. Here was an extraordinary escape from immediate danger ; the remedy was continued, and the ship lay for thirty hours in the trough of

the sea, free from the danger of broken water, and protected by the application of the oil, until, at the end of that time, the hurricane passed away, and the ship was enabled to proceed on her voyage uninjured. It is not too much to say that had it not been for the efficacy of the oil, the ship, in her helpless condition, must have succumbed to the violence of the hurricane, and probably all on board would have perished.

The great danger of the sea is not from the height to which the waves sometimes rise; waves are not dangerous from their height, unless they break at the top. On the day after a storm, when the wind has fallen, a tremendous swell will often be seen, the waves rising to a considerable height; but no danger is to be apprehended from waves of this kind, however unpleasant they may be to non-seafaring passengers. It is when the winds howl, and the white sea-horses are seen raising their snowy crests, that the sailor knows danger to be at hand. Should any one of those black walls of water crowned with white, crash on to the deck of the ship, the results would be terrible. The oil cast upon the waves does not cause them to go down, and form a calm spot amongst the turmoil; it merely, in certain cases, prevents the waves from breaking, and turns a raging sea into a heavy swell.

It is only in certain cases that ships can be brought into the water which has been treated with oil; if a ship is sailing or steaming with the wind on her beam, at right angles to the course on which she is steered, the oil cannot be so distributed as to lie on the water through which she is going. But should the vessel be in great danger from the waves which are breaking around her, the following plan can be pursued. The vessel should be hove to, that is, steered nearly into the wind's eye, and kept as stationary as possible; she will then drift slowly to leeward, that is, in the same direction as the wind. One or more oil-bags attached to light lines should be put overboard to windward, and the result will be that the vessel, being more exposed to the wind, will drift more rapidly than the bags, which will be left some distance to windward, and thus intercept and mollify waves which would otherwise come leaping and foaming towards the ship.

As, to be any protection, the oil must be distributed over the sea in the direct line from which the seas are advancing, and at a sufficient distance to give it time to spread and act upon the waves before they reach the vessel to be protected, it follows that, as regards any small boat, the oil can only be used when it is in one of two positions, namely, when anchored and lying head to sea and tide, or when running dead before the sea for the shore. In the first case the waves would

approach the bows of the boat, over which oil should be poured, or, better still, a bag of oil floated some yards in front of the boat, attached by a light line to the anchor so that the oil may spread all round. In the second case, when the boat is running with the wind and waves, the danger would be lest a wave should follow on so quickly as to break over the stern of the boat and overwhelm her. Oil poured over the stern of the boat will, to a certain extent, quiet these following waves, and prevent such a risk. It has to be noted that the calming effect of the oil is greatest in deep water, and the results are more marked and beneficial at sea than in surf or breakers, where it is shallow water. In surf, or waves breaking on a bar in shallow water, the effect of oil is uncertain, as nothing can prevent the larger waves breaking under such circumstances, but even here oil is of some service.

An official report upon the use of oil at sea for modifying the effect of breaking waves, is given in a memorandum from the Admiralty, of 16th June, 1886, giving a report by Captain Chetwynd, of 30th September, 1884, to the National Lifeboat Institution upon this subject, with directions for the application of the oil. Admiral Cloué, of the French Navy, gave to the Academy of Sciences, 6th June, 1887, the results of more than 200 experiments that had been made upon the subject, mainly in England and America, and he concludes that there can no longer be any doubt that oil has a most efficacious result in calming storm-tossed waters, and thus saving vessels in danger of foundering at sea. He says fish oils appear the best for the purpose, mineral oils owing to their lightness are less effective.

The United States Hydrographic Office, in calling attention to the subject in 1887, states that there is now ample evidence that the use of oil is of considerable service in lessening the effect of dangerous seas. It is noticed that the "slick" made by the oil has extended as far as thirty feet to windward, and it is concluded that the oil is of use when a vessel is reaching ahead at a speed of eight or nine knots an hour, with a beam wind and sea.

Much of the action of the oil seems to be simply as a direct lubrication between the surface of the water and the air, reducing the friction between them. This friction is very considerable ordinarily, and much greater than at first appears possible; and it is shown by the heavy scud seen flying in a gale at sea, which is water lifted up and carried a long distance by the friction of the air passing over the surface of the sea. The crests of waves are torn off and carried away by violent gusts of wind; and a great source of danger in a

storm is a mass of water that has been thus lifted into the air crashing down upon the deck and swamping a vessel. The extreme case of friction between the air and the water is a waterspout, in which a great mass of water is lifted up bodily high into the air, and held suspended there by mere friction between the air and the water. This remarkable friction only shows in storms and hurricanes, where the air is moving at a very high velocity whilst the water is stationary, causing an enormous number of particles of air to come in contact with each single particle of the water; and, though the moving effect of each single particle of air can be only extremely minute, the total accumulated effect becomes enormous. The action of the oil as a lubricant upon the surface of the water is so efficient, that the air sweeping over it at a high velocity is unable to catch hold of the surface and lift the water, and an exceedingly thin film of oil, a mere scum, is found sufficient for this purpose. The small quantity of oil that is consequently required, the simplicity of the means of application, and the great success and value of the results that have been obtained, render this plan well worthy of general adoption.

ON KEW GARDENS AND SOME OF THE BOTANICAL STATISTICS OF THE BRITISH POSSESSIONS.

BY J. G. BAKER, F.R.S., F.L.S.

(Continued from page 170.)

THE HERBARIUM AND LIBRARY.

The main object of the Herbarium and Library is to furnish the means of identifying the living plants indicated in the Garden, the dried plants that are sent home from India and the Colonies, or are collected by British explorers in other parts of the world, and the economic specimens that are sent to the Museum. The Herbarium is kept in the large brick house, fenced round with tall iron railings, which stands at the north-west corner of Kew Green, which was formerly occupied by Ernest, Duke of Cumberland, the fourth son of George III., and afterwards King of Hanover. Ten years ago a three-storeyed room, 80 feet long, was built for the express purpose of accommodating the cabinets of dried plants. It is open from floor to roof, and has two galleries, reached by spiral staircases of iron. Between each row of cabinets there is a window and a table, so that there is plenty of light, and

the plants in the cabinets do not need to be carried far when they have to be consulted. The most important part of the collection is the set of Indian and Colonial plants. Here are deposited the types from which the descriptions in the Indian and Colonial floras were made, and the whole collection is so arranged that, of almost any of the 46,000 plants that grow on British soil, a specimen duly named and authenticated can be referred to in a few minutes. Besides these the Herbarium contains a large collection of plants from other parts of the world.

At the death of Sir William Hooker it was estimated to contain one million specimens, counting as one all individuals of the same plant from the same locality. At present about twenty thousand specimens are added every year. When dried collections are examined, the rule is that in recompense for the trouble of naming them the Herbarium is allowed to keep whatever is required, and it is to a large extent in this way that its growth goes on. At present, for instance, Dr. Aitchison, the naturalist attached to the Afghan Boundary Commission, is engaged in working out the identification of the eight hundred species he has collected. During the last ten years the missionaries in Madagascar have sent home 5,000 numbered specimens, and of these the determinations have been sent out to them, and the new species of which there was enough material, 700 or 800 in number, have been described and named.

For any little-known country like Madagascar the plants that grow wild there are one of the best tests of its climate, and furnish a guide to the useful plants that may be cultivated with a fair chance of success. The foundation of the Kew Herbarium was the private collection which Sir William Hooker brought with him from Glasgow in 1840, and to this was added the herbarium of Mr. Bentham, and a set of the specimens collected in the Antarctic and Indian travels of Sir J. D. Hooker. Of late years the principal special additions have been the European herbaria of Gay and John Stuart Mill, the orchids of Lindley, the British herbaria of Watson and Borrer, the mosses of Bruch, Schimper, and Hunt, the lichens of Leighton, the algæ of Mrs. Griffiths, and the fungi of Berkeley and Cooke. Besides the Indian and Colonial floras, Mr. Bentham and Sir J. D. Hooker have elaborated a "Genera Plantarum," in which the ten thousand genera of flowering plants are fully described and classified under their natural orders. This was the work of twenty years, and it is used in the Garden, Herbarium, and Museums as the standard of nomenclature and classification.

Two periodicals are published in connection with Kew, the "Botanical Magazine," in which six new or interesting plants fit for garden cultivation are figured every month. This is now in its 112th volume, and contains nearly 7,000 coloured figures, all drawn from living plants. In the "Icones Plantarum," of which the seventeenth century is now in progress, the more interesting new plants that come to Kew in the form of dried specimens are figured and described. In the same buildings as the dried plants there is as full a collection of all the books and pamphlets on botany as the authorities have been able to get together. The number of volumes is about ten thousand. This occupies four of the rooms of the old palace. There is also a large collection of drawings, arranged in portfolios in systematic order. For naming living plants from the Garden these drawings are very much used, for of course they show the colouring of flowers far better than the dried specimens possibly can.

MUSEUMS OF ECONOMIC BOTANY.

There are three Museums in which are stored the collections of timbers and economic products. The principal Museum is the large three-storeyed building which stands in the centre of the Garden on the opposite side of the sheet of ornamental water to the Palm House. This is devoted to the products of the 150 natural orders of Dicotyledons, arranged in glass cases in systematic order. A similar collection of the products of the Monocotyledons and Cryptogamic natural orders is contained in a smaller museum, which stands at the north end of the Herbaceous Ground. In the old Orangery, not far from the main gate and the palace, are the large specimens of timber. Many of the specimens in these museums are derived from the great Exhibitions of 1851 and 1862, and from the India Museum. In addition to timbers, textile fabrics, food grains, medicines, and models of edible fruits, these museums contain the specimens of fruits and seeds which are too large to be mounted on the sheets of paper at the Hebarium.

VALUE OF VEGETABLE PRODUCTS.

Just consider for awhile what a large proportion of the food and clothing of mankind has to be derived from the Vegetable Kingdom. Last year the value of the agricultural crops grown in Great Britain alone amounted to £136,000,000. The value of the grain and flour imported amounted to £67,000,000. These two added together amount to over £200,000 000, or an average of £6 per head for each person

in the country. The exports of the United States, mainly grain and cotton, amounted last year to 750,000,000 dollars, or nearly £150,000,000. The total exports and imports of India last year amounted to £131,000,000, and of this materially over £100,000,000 belonged directly to the Vegetable Kingdom in one form or another.

THE FUTURE OF THE ANGLO-SAXON RACE.

Consider, also, to what a large extent the future fortunes of the British Empire depend upon a proper development of the capabilities of our Colonial possessions to produce the vegetable crops that are useful to the human race for food, clothing, medicine, and other economic uses. Our population is now 350 millions; what will it be in a hundred years time? Notwithstanding emigration, the population of Great Britain has doubled in the last half-century, whilst that of France, which in the seventeenth century amounted to 38 per cent. of the whole population of Europe, now hardly attains 13 per cent. To 350 millions add fifty millions for the population of the United States, which has increased above 20 per cent. during the last ten years. The estimate recently put forward by Mr. Gladstone does not seem at all an extravagant one, that in a hundred years' time it is not improbable that the English-speaking race and its subjects will amount up to a population of 1,000 millions. How all these men and women and children are to be supplied with needful food and clothing is a problem that will try to the very uttermost the knowledge and the foresight, and the energy and the enterprise, of the generations that are to follow our own.

(To be continued.)

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—MICROSCOPICAL SECTION, June 6th. Mr. J. F. Goode read a paper entitled, "Notes on some Foraminifera, collected and mounted by Mr. E. W. Burgess, from Material obtained near Oban by the Society, during their dredging excursion in 1883," illustrated by specimens in microscopes and by a fine series of micro-photographs by J. Edmonds, exhibited in the oxy-hydrogen lantern, by Mr. C. Pumphrey. Mr. Pumphrey afterwards gave by the same lantern an interesting exhibition of fine photographs of flowers and other objects.—MICROSCOPICAL SECTION, July 3rd, Mr. W. B. Grove, B.A., exhibited *Peziza clavus* and *P. ebuli* (new to the district), *Ascobolus immersus* and *Sordaria discospora* from Clent Hills; and also (for Miss Gingell) *Ag. gambosus*, *Ag. carneus*, and *Peziza acetabulum* from Dursley.

Mr. W. H. Wilkinson exhibited an abnormal gooseberry from Handsworth, being developed on one side only, giving a curved appearance to the fruit. As three trees were affected in a similar manner, it may have been caused by the severe weather injuring the upper side. He also exhibited *Meconopsis cambrica*, *Orchis conopsea*, *O. incarnata*, *Claytonia sibirica*, *Oxytropis uralensis* (very rare), *Aira præcox*, and other interesting plants from the Island of Bute and Scotland.—BIOLOGICAL SECTION, July 10th. Mr. R. W. Chase presiding. Mr. W. R. Hughes, F.L.S., as one of the delegates from Birmingham, gave a full and graphic account of the meeting of the Midland Union of Natural History Societies, held at Northampton the previous week, and of the very excellent conversazione which followed. At the general meeting Earl Spencer presided, and after an excellent opening speech, presented the Darwin Gold Medal, this year awarded in Botany, to Mr. J. E. Bagnall, A.L.S. Mr. W. H. Wilkinson also a delegate, gave an account of the Botanical Excursions, and exhibited some of the plants collected, amongst which were *Epipactis latifolius* and *Habenaria chloroleuca*. Mr. W. B. Grove, B.A., exhibited some of the fungi collected at these excursions:—*Agaricus rubescens*, *Ag. squarrosus*, *Ag. Xanthopus*, &c.; also *Ag. phlebophorus*, from Sutton, new to the district. Miss Germain also gave an account of the Archæological Excursions, and exhibited photographs of some of the more interesting buildings in Northampton. Mr. J. E. Bagnall exhibited *Isohecia migurum*, and other mosses from Bearley and Lapworth; for Mr. J. B. Stone, F.L.S., mosses from the Bernese Oberland, collected during a recent visit, at 6,000 feet above sea level, including *Hypnum Oakesii* and *Bartramia Oederi*; for Mr. S. Walliker, mosses and lichens from the Swiss Alps, collected by Mrs. R. Peyton; for the Rev. D. C. O. Adams, *Habenaria bifolia* and *Senecio campestris*, from Crowell, Oxon; for Miss Gingell, a number of rare Gloucestershire plants, including *Astragalus hypoglottis* and *Habenaria chloroleuca*; and for Mr. R. W. Chase, from his garden at Edgbaston, a peculiar fasciated stem of the holly, in which five or more branches had coalesced so as to form ribbon-like branches, the whole plant being more or less abnormally developed.—SOCIOLOGICAL SECTION. Supplementary meeting, June 7th. Mr. W. R. Hughes, F.L.S., in the chair. A letter from Dr. Hiepe was read, announcing his resignation from the society on account of his leaving the neighbourhood. In consequence of the illness of Miss Dalton, the chapter of Mr. Herbert Spencer's "First Principles" on "The Data of Philosophy" was not taken, but in lieu thereof Mr. W. R. Hughes gave an exposition of a portion of Mr. Spencer's essay on "Progress: its Law and Cause." Fourteen members present.—Supplementary meeting, June 21st. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Hughes communicated the agreeable information that he had called upon Mr. Herbert Spencer, and found him greatly improved in health. It was decided to discontinue the meetings of this section during July and August. Mr. Stone exhibited the skull of an aboriginal Australian, and Professor Allen procured two normal skulls for comparison, and explained the points in which they differed from the Australian. Miss Dalton gave her exposition of the second chapter of the second part of Mr. Herbert Spencer's "First Principles," entitled "The Data of Philosophy." Fourteen members present.—Ordinary meeting, June 26th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. J. J. Bagnall, Bentley Heath, Knowle, proposed by Mr. C. T. Parsons, and seconded by Mr. Edmund Tonks, was elected a member of the society. Mr. J. J. Crisford was proposed as a member by Mr. W. R. Hughes, F.L.S., and seconded by Mr. W. B. Grove, B.A. Mr. Grove exhibited specimens

of *Peziza coronaria*. Mr. Wilkinson exhibited a fine specimen of proliferous daisy, *Bellis prolifera*, having seventeen flowerets. Mr. W. R. Hughes exhibited the English portion of Mr. Herbert Spencer's "Table of Descriptive Sociology." Mr. W. Morley exhibited a number of ferns from the fernery of the late Mr. J. Morley. The President exhibited two larvæ, and read a communication concerning them from Mr. Lloyd Bozwani, of Worcester. Mr. F. J. Cullis, hon. sec. of the section, read the second part of his paper on Dr. John Fiske's "Cosmic Philosophy." Fifteen members present.—Ordinary meeting, Tuesday, July 24th. Mr. W. R. Hughes, F.L.S., in the chair. Mrs. Browett exhibited *Peziza coronaria* from a garden. Mr. Hughes exhibited a species of saw fly, found in imported timber used at Hamstead Colliery. Mr. Stone exhibited specimens of young furze (*Ulex Europæus*), showing the transition from the tripartite leaves that appear immediately above the cotyledons to the characteristic spines. Eight members present.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—June 18th. Mr. J. Collins gave a report of a visit made on the previous Saturday afternoon by members and friends to Hamstead Park, by the kind permission of George Kynoch, Esq., M.P., when many interesting objects were taken. Mr. J. Madison reported 23 species of slugs and snails. Mr. Hawkes showed a fungus *Pilobolus Kleinii*; Mr. J. Moore, a specimen of *Dytiscus marginalis*, covered with vorticella; Mr. Madison, *Arion ater*, var. *rufa*.—June 25th. Mr. Corbet showed pebbles from the drift, containing parts of *Phacops candatus*; Mr. Sutton, root-galls of oak; Mr. J. W. Neville, the butterfly orchis, *Habenaria bifolia*. Under the microscope: Mr. H. Hawkes, a marine alga, *Calliblepharis ciliata*; Mr. Moore, sections of butcher's broom; Mr. J. W. Neville, leaf of *Deutzia corymbosa*, compared with that of *D. scabra*.—July 2nd. Mr. H. Hawkes exhibited *Æcidium geranii* from Llandudno; Mr. Hopkins, a collection of shells from Hamstead Park; Mr. J. Madison, a specimen of *Helix arbustorum*, var. *albinus*, from near Thorpe.—July 9th. Mr. J. Collins read a paper on "Plant Hairs and their Modifications." The writer said, on careful consideration we should find this subject a most important one, particularly to the microscopist. He should have to refer to hairs of various kinds, including prickles, scales, glands, &c. The first form of hair is of papillose structure. Many hairs are short-lived, and are not found on mature plants. The modifications of hairs for useful purposes are many and interesting, and were described under the following heads:—Root hairs, as the only organs capable of absorbing nutriment; hairs of stem as prickles which soon die, not being found on old stems, and hairs of leaves. They doubtless existed as a protection from extremes of temperature, from drought, from the injurious effects of foreign matter, and from the ravages of animals. The hairs of floral organs were even more beautiful than those just referred to, and were useful in connection with insects' visits. Glandular hairs are very common on flowers, and are a defence to the organs. The paper concluded by referring to the theory of the Rev. G. Henslow on the origin of plant hairs (that as they grow where they are of most use, they are the result of irritation to the parts) as a feasible one, and trusted many present would be stimulated to observe these interesting objects. The paper was illustrated by a series of slides under the microscope.—July 16th. Mr. J. W. Neville exhibited specimens of *Lingula attenuata* and other fossils from the Llandeilo formation. Mr. Corbet, *Ammonites Johnstoni* and other fossils from Wilmcote.

INSULARITY. *

BY THE REV. H. H. SLATER.

This seems, perhaps, at the first glance, rather an odd subject to choose for an address to a gathering of Natural History Societies, but I mean to justify its selection, if I can.

You are aware that foreigners call our British manners and ways of thought and action “insular”—a slightly contemptuous way of hinting that our views and aims are as restricted as our boundaries. It is not for me to determine, nor is this the occasion to consider, how far this epithet is generally applicable—though I think that we shall mostly be inclined to admit its justice to some extent. I have no thought, however, of inflicting upon you a general ethical disquisition upon our national characteristics, but rather I would on the present occasion ask your indulgence while I consider whether we do not, in some degree, lay ourselves open to a charge of narrowness in our scientific aims and interests—whether we are not too easily satisfied in confining our studies within the narrow limits of our own islands, or even within the narrower boundaries of our own county, or even parish—and whether British science as a whole, and our own breadth of view, do not suffer in consequence.

At present we shall have to admit that cosmopolitan scientific study is confined to London. There are, generally speaking, no other journals or publications, except those issued in the metropolis, which do not confine themselves to subjects, at any rate, within our own islands. If you purposed to visit any particular part of Asia, or Africa, for example, and desired to prepare your ideas beforehand as to the geology, or fauna, or flora—or some part of one of these in which you happened to be interested—you would find the back numbers of no provincial journal of much use to you. Or if you chanced to be studying some natural group of animals or plants—and by a natural group I mean a closely related group, wherever the members of it happen to be indigenous—you would be obliged to go up to London to do so, for it would be next to impossible to get the opportunity of examining any number of specimens, or to have access to any considerable amount of literature on your subject anywhere else—for you would in other parts of the country be restricted to British, or even local, species and specimens, and the literature only respecting *them*.

* Address delivered at the Annual Meeting of the Midland Union of Natural History Societies, held at Northampton, July 4th, 1888.

There is a very different state of things in Germany, and more or less, in most European countries nowadays. And America is undoubtedly far in advance of Europe in this respect. I feel that we provincials have much to learn from this point of view, which, if learnt, would make our local collections of far greater value than they are at present, and our local journals of more than what they are now, of merely ephemeral interest. From the working zoologist's or botanist's point of view, they are both of them at present—generally speaking—what the French would call a negligible quantity.

It would be all very well if we could only suppose that Great Britain formed anything approaching to a natural zoological or botanical region. But we cannot pretend to maintain this view. As far as zoology is concerned—with which I am more conversant, and to which you will kindly take my remarks as principally referring—Great Britain cannot be looked upon as forming even the semblance of a definite natural region; our fauna is almost exactly identical with that of Western Europe in general; but I believe that the same is also the case with the flora. As far as birds are concerned, we have only one species—the red grouse—which can be considered peculiar to Britain, and a few subspecies, such as the British forms of the long-tailed, and coal titmice. Our mountain and winter birds are all but identical with those of Northern Europe, and our lowland and summer birds with those of Central Europe—the principal difference being, that our British list is poorer in the number of species. It is generally admitted by zoologists that the whole of Europe, Africa (north of the Sahara), Asia Minor, and Palestine and Arabia, and all Asia north of the Himalayas and the Yangtse Kiang basin, form one large natural zoological region. This is divided into two sub-regions, by drawing a line southwards down the Ural Mountains to the Persian Gulf, into the Eastern and Western Palæarctic sub-regions.

It would indeed be strange, in face of this system, if the fauna of our islands were thought to be worth studying independently, seeing the facility with which birds can, under favourable circumstances, and do habitually, make nothing of its boundaries.

It is to our manifest disadvantage, therefore, if we attempt to restrict our studies to mere local matters. Our scientific horizon is, of necessity, in that case a very narrow and limited one, if we steadfastly ignore all the rest of the world. To take an example, there are a certain number of birds which

visit us only in the winter—let me instance the fieldfare, redwing, brambling, and short-eared owl (as we are inland folk mostly)—which take up their quarters with us during a few months in the year, and regularly every year. What do we know of them on the whole? We can recognise the bird when we see it, perhaps; its note, perhaps; we know what it feeds on, perhaps—while it is with us; what more? Perhaps we religiously buy its eggs, or what pass for its eggs—we cannot be sure—because it is classed as a British bird; we have a specimen or two mummified in a glass case, with a number of incongruous vegetables and insects. But what do we know of it on the whole? Truly, very little. So with the birds which visit us in the summer, after these others have taken their departure, which visit us for reasons, perhaps, which they could hardly explain if they could speak, but would be driven to take refuge in an answer which many men are apt to bring up as a triumphant reserve (though, to my mind, a very irrational, and often unsatisfactory one) when they are required to give a reason for half the things they do—“My father, my grandfather, and my great grandfather used to do so, and that is enough for me.” We know the summer birds’ notes and appearance, perhaps; we examine their nests, and know what sort of places to expect them in; we even know their range in Britain, perhaps. As to where they go when they leave us, what is their range in Europe and in the world generally, whether their habits are different in other lands, the species closely allied to them, and their differences in appearance and habits and range from these—to all these things, which go to make up what strictly deserves the name of scientific knowledge—to such matters we are, too often, profoundly indifferent. And again I am constrained to remark, pity it is so.

We should, undoubtedly, have a far higher claim to the possession of true scientific knowledge if we were to confine our attention to one moderate-sized genus of mammalia, birds, insects, mollusca, or plants, and worked out the distribution of that genus in the world—zoologically (or, in the case of plants, botanically) and palæontologically—and familiarised ourselves with every member of that genus, its area, economy, habits, and uses, than by ever so general a study of the whole class as exemplified only in Great Britain.

And that leads me to express my wonder why we do not pursue our studies abroad more. All professional and commercial men nowadays have, more or less, their holidays, if nothing more than a few days at Easter, Whitsuntide, and Christmas. In these days of cheap and rapid travelling, why

do we not take more advantage of it? Many of us could manage a birds'-nesting trip, or a plant or insect hunting trip, or a foreign geological tour of a few days to Holland, or France, or Spain, or Switzerland, under the wing and auspices of Mr. Cook and his brethren. But, I think, you will agree with me that it is an exceptional circumstance for English naturalists to do so. When we English do go abroad it is, as a rule, to rush, guide-book in hand, through a given number of cities, like a whirlwind; or to pound resolutely along a lot of dusty highroads on a bicycle, happy if we can do our fixed number of kilométres in the day—robbed of all interest in our dinner if we fall short of the allotted distance—bringing back with us no very definite idea, save that we have “done” so many towns or miles in so many hours. Is not this a legitimate caricature of the British tourist? But could not we naturalists—at Whitsuntide, for instance—get a few days in a new field, with a trusty companion, and add to our storehouse of facts and observations, or even to our cabinets, experiences which might be a valuable possession to us for the whole of our natural lives.

But why do we so often prefer to, what I must call, *waste* a fortnight or three weeks at home, in some semi-fashionable sea-side town or inland watering-place—doing nothing whatever, and trying to fancy we like it—paying dear for ill-cooked meals in stuffy lodgings or a racketty hotel—when the same expenditure would have given us (unless our number of olive branches is abnormally large) a far more delightful and equally health-giving tour in Norway or Italy, from which we might have returned with, for example, a whole bale of dried plants, enough to occupy, with absorbing interest, all our unemployed evenings through the next winter, and forming a valuable item in our collection of reference?

(*To be continued.*)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

EDWIN LEES IN HAST. “ILL. NAT. HIS. WORC.,” *continued.*

(*Continued from page 207.*)

- * *Iris foetidissima*, 150. Near Alfrick, and at the western base of Crookbarrow Hill. Also about Pershore, in woody places. S.G.
- * *Crocus vernus*, 150. Very rare. Several plants were found a few years ago in the middle of a meadow between Worcester and Crookbarrow Hill, by Mr. James Goodman, who pointed them out to Mr. Lees. L.M.

- * *Narcissus Pseudo-Narcissus*, 160. In a wood at Little Malvern, and covering a whole meadow between Malvern and Cradley. Severn meadows at Kempsey, and in a wood at the Nash, near Kempsey. S.G. L.M.
 - * *N. biflorus*, 159. In an orchard beyond the Ketch, perhaps a suspicious place; but truly wild and abundant on the banks of Sapey Brook, near a travertine rock called the Hoar Stone. Mr. Lees. In a pasture at Bagnall, near Kempsey. Dr. Streeten. S.G.
 - † * *Galanthus nivalis*, 159. Occupying the virgin turf in a glen at the northern base of the Herefordshire Beacon, apparently wild. *This locality must be in Hereford.* S.G. L.M.
 - * *Paris quadrifolia*, 162. In deep shady groves, at Witchery Hole, near Clifton-on-Teme; woods at Malvern, Eastham, Stanford, &c. S.G. L.M.
 - * *Convallaria majalis*, 160. Abundant in Shrawley Woods. More sparingly in Bewdley Forest. S.G.
 - * *Tulipa sylvestris*, 160. Very rare. In a little copse on the red marl bank at the Ketch, near Worcester. Mr. Lees. S.G. L.M.
 - * *Ornithogalum nutans*, 160. In a meadow near Kempsey Grove. S.G.
 - O. umbellatum*, 160. In a meadow near Dr. Berkley's, at Cotheridge. Mr. Walcot.
 - * *Allium vineale*, 160. Pitchcroft. S.G.
 - * *A. oleraceum*, 160. Abundant on the Ketch Bank. With double heads of bulbs at Battenhall, near Worcester. S.G.
 - * *A. ursinum*, 160. Very abundant in Ockeridge Wood, near Holt. In various other moist coppices. S.G.
 - * *Colchicum autumnale*, 161. Abundant in almost every moist meadow in the county. S.G. L.M.
 - Luzula congesta* (*L. multiflora*), 160. Perry Wood. Hartlebury Common.
 - * *Juncus uliginosus* (*L. supinus*), 160. Hartlebury Common, Malvern Hills.
 - * *Eleocharis acicularis*, 151. Bogs at the foot of the Malvern Hills, in several places. S.G.
 - * *E. palustris*, 151. Banks of a pool at Kinnersley. Dr. Streeten.
 - * *Scirpus sylvaticus*, 151. By the large pool in Shrawley Wood. Mr. Lees.
 - * *Eriophorum angustifolium*, 151. Abundant in a large bog on Hartlebury Common.
 - * *E. polystachion*, 151. Bog at the base of the Worcestershire Beacon, Malvern. L.M.
- E. angustifolium and E. polystachion are the same species.*
- * *Carex pulicaris*, 177. In a bog at the base of the Worcestershire Beacon, Malvern, and on other parts of the Hills.
 - * *C. stellulata*, 177. With the above.

- * *C. muricata*, 178. Bredon Hill, &c.
- * *C. remota*, 178. In woods at the base of the Malvern Hills.
- C. axillaris*, 178. Banks of Sapey Brook. In a bog at Wyre, near the Avon.
- * *C. pendula*, 178. In great abundance in Wayman's Wood, Clifton-on-Teme. Also by a rill, near Elmley Castle. Mr. Lees.
- † *C. Œderi*, 178. Spring by the road side, near the Turnpike beyond Great Malvern. Dr. Streeten.

This is not the true C. Œderi, but C. flava var. minor of Townsend, C. lepidocarpa of some authors.

- * *C. ampullacea*, 178. Banks of the Salwarp. Pool on the eastern side of Hartlebury Common.
- * *C. vesicaria*, 178. Pool at Glasshampton, and at Ham Castle. Mr. Lees.
- * *Phalaris arundinacea*, 151. Banks of the Severn, Kempsey, &c.
- * *P. canariensis*, 151. Near Gregory's Mill, Worcester.
- Alopecurus agrestis*, 151. Corn fields, at Brook-end, near Kempsey.
- A. geniculatus*, 151. Severn meadows, Kempsey.
- * *Arundo* (*Calamagrostis*) *Epigejos*, 152. Eastern side of Perry Wood.
- * *A. Phragmites* (*Phragmites communis*), 152. By the side of brooks, and marshy places, at Hindlip, near Worcester, and on the banks of the Avon.
- * *Milium effusum*, 151. Woods and groves. Perry Wood. S.G.
- * *Aira flexuosa*, 151. Malvern Hills. S.G.
- * *A. caryophyllea*, 151. Shrawley Wood, Malvern Hills, &c. L.M.
- * *A. (Kæleria) cristata*, 151. On the red marl cliff at the Ketch, two miles south of Worcester. Dr. Streeten.
- Melica nutans*, 152. In Bewdley Forest, not far from Dowles Brook.
- * *Glyceria aquatica*, 152. Pools and ditches in the vicinity of the Severn.
- G. rigida*, 152. Near the Ketch, on the Bath Road, between Kempsey and Worcester. Dr. Streeten.
- * *Festuca pinnata* (*Brachypodium pinnatum*), 152. Near Pershore. S.G.
- * *F. sylvatica* (*B. sylvaticum*), 152. Perry Wood, Shrawley Wood, &c.
- Bromus asper*, 152. Perry Wood.
- * *B. diandrus*, 152. Severn Stoke. *Probably only a repetition of the record by Stokes.* S.G.
- B. racemosus*, 152. Severn meadows, Kempsey.
- * *Nardus stricta*, 151. On Hartlebury Common, and Malvern Hills. S.G. L.M.
- * *Blechnum boreale*, 180. In Bewdley Forest, on Bromsgrove Lickey, Stagbury Hill, in Shrawley Wood, and at the base of the Malvern Range.

* **Asplenium Ruta-muraria**, 180. On an old wall bounding the "Dark Alley," near the Cathedral. Also on walls at Martley and other places.

A. viride, 179. Found by the late Mr. T. B. Stretch growing on Ham Bridge, near Clifton. It is, however, eradicated, for some improver has plastered a coat of whitewash over every part of the bridge. *This the first notice of the habitat. The fern was not eradicated at the time supposed. It was seen by Mr. Edward Newman in 1843 ("Phytologist," Vol. I., p. 671), and I possess a specimen gathered by myself from the same spot, on the 31st August, 1844. Mr. Lees tells us in his "Botany of Worcestershire," p. 87, that the Herbarium of the late Mr. T. B. Stretch, of Worcester, passed through his hands in the year 1827, and that he observed in it a specimen of Asplenium viride, "with the habitat of Ham Bridge;" also that it disappeared in 1853 in consequence of a renovation of the structure, and that the late Mr. Haywood, seedsman and florist of Worcester, seeing the fern prostrate in the road, carried it home and planted it in his fernery at Wick.*

A. Adiantum-nigrum, 180. On the rocks of the Malvern Hills, abundantly though small. In shady lanes on the west side of Worcester, and at Kempsey growing very luxuriantly. With variegated fronds on Rosebury Rock.

* **Aspidium (Athyrium) Filix-fœmina**, 179. In abundance round the springs of the Malvern Hills, especially in the glens at the base. St. Catherine's Well, Sapey.

A. irriguum, 179 (*a form of the last*). In the bog at the base of the Worcestershire Beacon, Malvern.

* **Scolopendrium Ceterach** (*Ceterach officinarum*), 180. Rare in this county. On Malvern Abbey Church. Walls at Badsey.

* **S. vulgare**, 180. Not uncommon in moist places.

* **Cystea (Cystopteris) fragilis**, 179. In the neighbourhood of Bromsgrove. Mr. Maund.

This is probably the same habitat as that recorded by Miss Read, in Withering, 3rd Edit., 1796, p. 779.

* **Aspidium aculeatum**, 179. Very abundant in the stony lanes about Suckley.

A. lobatum, 179. Growing magnificently in the shady dingles by the Spout Brook at Eastham.

A. angulare, 179. In the woods at Suckley and Leigh Sinton.

* **A. spinulosum**, 179. About Bromsgrove Lickey. Also at Blackstone Rock.

* **A. dilatatum**, 179. Abundant on the declivities of the Malvern Hills, and among moist thickets in the valleys below. Also at the base of Bromsgrove Lickey, and on Blackstone Rocks.

* **A. Oreopteris**, 179. At the western base of the Worcestershire Beacon, Malvern. Messrs. Walcot and Lees.

Polypodium Dryopteris, 179. In considerable plenty among the loose stones occupying the glen between the North and End Hills, Malvern; pointed out by Mr. Salisbury.

What Mr. Salisbury is here referred to, or when he pointed out the fern, Mr. Lees does not inform us. It was still growing in the same locality, and on the western declivity of the Worcester Beacon, in 1867 and 1868, as stated by Mr. Lees in the "Botany of Worcestershire," p. 75, and in the "Botany of the Malvern Hills," 3rd Edition, 1868, p. 118. It has since been eradicated.

† *P. calcareum*, 179. In the same vicinity, according to Mr. Salisbury. *An error. "The true P. calcareum has not hitherto been found," Ed. Lees, "Botany of Worcestershire," p. 75.*

Lycopodium inundatum, 180. In the large bog on Hartlebury Common. Mr. Lees.

* *Equisetum palustre*, 180. Hartlebury Common, bog at Wyre, &c.

E. fluviatile, 180. Boggy glen near Crookbarrow. Also at Alfrick, Malvern, &c.

Equisetum fluviatile of Smith is *E. Telmateia*, Ehrh.; *E. maximum*, Lam. The latter is the plant intended; see "*Botany of Malvern Hills*," 2nd Edit., p. 84.

Several of the plants noted in the "Strangers' Guide" and in "Loudon's Magazine" do not reappear in the above catalogue.

Among the former are *Lonicera Caprifolium*, *Hordeum sylvaticum*, and *Ornithogalum pyrenaicum*, which is replaced by *O. umbellatum*. Among the latter are *Cuscuta Epithy-mum* and *Mentha viridis*. It is strange that Mr. Lees should have overlooked Perry's list, although it appeared in "Loudon's Magazine" in 1831.

(To be continued.)

A CHAPTER IN THE PHYSICAL GEOGRAPHY OF THE PAST.

PRESIDENTIAL ADDRESS
GIVEN TO THE BURTON-ON-TRENT NATURAL HISTORY
AND ARCHÆOLOGICAL SOCIETY.

BY HORACE T. BROWN, F.G.S., F.I.C., F.C.S.

(Continued from page 203.)

The same graving tools of nature which removed the upper measures have also cut deeply into the Limestone itself, producing those lovely and picturesque dales which render our Derbyshire districts so beautiful.

We are thus enabled to form some idea of the immense amount of material which has been denuded from the central portion of the Pennine area. We have had swept away the whole of the Coal Measures, the Millstone Grit, Yoredale Shales, and a variable thickness of the Mountain Limestone itself, which must represent in the aggregate at the very lowest estimate 10,000 to 12,000 feet of rock. If the elevatory forces had not been compensated by the sub-ærial waste, we should have had not *hills* in Derbyshire but *mountains*, raising their heads far above the snow line of this latitude.

Although it is pretty certain that our range of hills at one time reached a higher elevation than at present, it is unlikely that this ever equalled the total thickness of strata which have been removed from its central portions; for we have reason to believe that the great upheaval was not the result of one sudden earth movement, but was brought about by a slow, gradual, and intermittent process, extending over a vast period of time. Under these circumstances those never-ceasing atmospheric influences, which are constantly at work through the agency of rain and river, must have commenced their wasting action as soon as the bottom of the Carboniferous sea was brought above the level of the water, and the erosion of wave and current would begin even before this. In this way the planing and sculpturing forces of nature almost kept pace with the upheaval, and the great anticlinal ridge was scarred, furrowed, and truncated from its earliest childhood.

We can trace the great north and south Pennine axis right through North Derbyshire into the West Riding of Yorkshire, a total distance of about 60 miles, but in the extreme north of the first mentioned county, the beds, of which the hills are composed, begin to bend over a little to the north, and this tendency increases rapidly as we travel further in the same direction. At the southern extremity, in the Weaver Hills, the Limestone is also seen to bend over gently, but in this case it is towards the south. It is evident, therefore, that we must to some extent correct our notion of this great anticlinal, which is not a mere arch of indefinite length, but a very long, low, elliptical dome of rock.

To return once more to the Yorkshire end of this dome, or *periclinal* as it is called, we notice that the north and south folding of the rocks gives place to great corrugations in a direction at right angles to this, that is east and west.

The result of this has been to bring up lower beds from beneath the Coal Measures, these latter having been entirely swept off north of a line drawn due east and west a few miles to the north of Leeds, as far as the Tees. These east and

west folds have impressed themselves on the physical conformation of the North of England, just as the great Pennine anticlinal has done further south ; for to them is due that system of east and west valleys, with high separating ridges, which run across the moorlands of Yorkshire. Here also, just as further south, the upper parts of the folds have been denuded right down to the Mountain Limestone.

Having now briefly considered the structure of the Pennine Hills, we must turn our attention for a short time to the Central Midland District immediately south of the termination of the range, and I must ask you to accompany me in imagination to the summit of the Weaver Hills near Ashbourne. Here, at a height of 1,200 feet above sea level, we find ourselves on the southern extremity of the Pennine Range. If we look upon the range as the "backbone" of England, we are now standing upon what an anatomist would call its *terminal caudal vertebra*. To the north is all the rugged hill country of Derbyshire, but to the south, the country over which we look, stretched out like a map at our feet, is of an entirely different character, and consists of a gently undulating plain, which, elevated only 300 to 400 feet above the sea, is in fact the western extension of the largest plain in the world. When standing on Weaver we look towards the rising sun, if it were possible to extend our powers of vision to an indefinite extent, and allow for the curvature of the earth, we should find no mountain or hill to obstruct our line of sight until our eyes rested upon the Ural Mountains, which divide Europe from Asia. Broken only by the inconsiderable ripple of these mountains, this mighty plain extends across the whole of Northern Asia.

In Europe the strata underlying the plain are of much more recent date than those constituting the Pennine Chain. At the base of the Derbyshire Hills they consist of sandstones and marls belonging to the New Red Sandstone series, which, sweeping round the base of the hills, follow every curve and inlet, so as to suggest, what is actually the case, that they were deposited round the flanks of the older rocks at a time when the high land of Derbyshire had its southern coast line in the Weaver Hills.

Far away to the south and south-east we can discern, rising out of the sea-like plain, three tracks of elevated ground, which mark the position of the Coalfields of South Staffordshire, Warwickshire, and Leicestershire, respectively. In all three of these tracts Carboniferous Rocks are again brought to the surface in dome-like masses, from which the overlying New Red Rocks have been stripped by the waste

of ages. These Carboniferous Rocks doubtless owe their present position to the action of the same forces which elevated the Pennine Range. In the case of the Leicestershire Coalfield, upon the western edge of which our town of Burton is situated, I shall be able to give you some proof of the correctness of this statement, but I shall have little time to refer to the South Staffordshire and Warwickshire areas. I may state, however, that, unlike the Derbyshire district, in all three of these Coalfields we have occasional glimpses of the old sea floor upon which the Carboniferous Rocks were deposited; thus affording us valuable information in our attempt to reconstruct the physical features of the country at that very remote period.

On the eastern side of what we may term our home district of the Leicestershire or Ashby Coalfield, this old floor upon which the Carboniferous sediments were thrown down has been bared to the light of day, exposing in Charnwood Forest a large tract of some of the oldest rocks in the British Isles, consisting mainly of slates, grits, volcanic agglomerates, and syenite, and occupying a ridge of ground about eight miles long and five miles broad.

Although the elevation of the Charnwood ridge does not, in its highest point, reach more than 900 feet above sea level, it presents, especially when viewed from its eastern side, a bold, serrated edge, in strange contrast to the gently flowing outline of most of the other hills of the Midlands. Its jagged and craggy summit, under certain atmospheric conditions, has a strangely mountainous aspect, and has often been justly compared with a miniature Alpine range. This resemblance, after all, is not a fancied one, for the Charnwood Hills have all the characteristics of a true mountain range. It was pointed out, many years ago by the late Professor Jukes, that here, within a very small area, and without any laborious climbing, we can study at our leisure nearly all the geological phenomena afforded by mountainous districts. Although of very diminutive proportions as compared with the mountain chains of Europe, we must bear in mind that denudation has played its part here also, and that it is only a ruin of its former self. Its elevation, doubtless coeval with that of the Pennine Range, took place at a very remote period of the world's history. The now lofty chains of the Alps, the Pyrenees, the Andes, and, in fact, nearly all the important mountain ranges of the world are but mere children in point of age when compared with the venerable antiquity of our Leicestershire hill country. In fact, the Charnwood area had an elevation far in excess of its present height, and had

been subjected to denuding forces ages before the sedimentary rocks, which form the greater part of those mountain chains, had even been laid down in their ocean beds.

The Charnwood ridge has been produced by an anticlinal fold with its axis running N.W. and S.E. This fold has been ruptured at the crown of the arch by the great forces which brought about its elevation, and the western ridge has in consequence been forced some 500 feet higher than the eastern. Such a rupture, attended with the vertical uplift of the rock on one side of the great earth crack, is called a *fault*, and if it had not been for the constant planing action of sub-ærial forces keeping pace with the slow uplift, we should have had one side of the range elevated as a lofty wall of rock above the other side. As it is, however, nature has so planed the surface that the old scar is not visible, and can only be inferred from the want of correspondence in the beds on either side of the anticlinal.

On the west of the Charnwood area the actual superposition of the Carboniferous strata upon their old sea bottom consisting of Charnwood Rocks, is not visible, owing to the existence of another large fault running parallel with the anticlinal fault, letting down the Coal Measures against the former. It is only on the north and north-west that the Mountain Limestone, the lowest member of the Carboniferous system, is found resting upon the Forest rocks; and here we find unmistakable evidence that the latter must have been immensely disturbed and denuded before the Limestone was laid down upon them. Such a super-position is known as an *unconformity*, in contradistinction to the term *conformity*, which is used to express an unbroken sequence of sedimentation, like, for instance, that of the various members of the Carboniferous system from the Mountain Limestone right up to the Coal Measures.

(To be continued.)

A CELLAR FUNGUS.

BY W. B. GROVE, B.A.

It is a striking fact that some fungi, when grown in dark or unventilated places, assume a form quite different from their normal one. The significance of this fact has not, to my knowledge, been investigated. There is a tough Agaric-like species, *Lentinus lepideus*, which was probably originally introduced into this country by foreign timber, in

which this transformation is frequently observed. Although it has been met with, it is said, on native timber, it usually grows on deal, and especially on rafters. It sometimes occurs in great numbers under railway bridges, if these are made of wood, but it is more common in cellars, growing on the rafters which support the floor above. It consists of a stem and pileus, like the common mushroom, but of a pinkish hue, the latter bearing white gills on its lower surface. Now the gills of the Agarics have, as is well known, a tendency to turn away from light. But the stem of the *Lentinus*, from the necessity of its position, grows at first downwards, and if it developed the pileus at its end in the usual way, the gills would be turned upwards and therefore most likely to receive what light there might be. To avoid this, the stem curls round, and at last points upwards, describing a complete semi-circle, and thus placing the gills in the normal position. But far more frequently, if the cellar has but little light, the pileus remains undeveloped, and the stem, even after it has curled round, terminates in a sharp point.



A more common and more complicated instance of this monstrosity, however, is found in *Polyporus squamosus*. This is the large coarse species so frequently found growing in tufts on old ash trees, though also on willow, elm, etc. It has a short, thick stem, invariably black at the base, and expands into a yellow pileus of the shape and consistency of a saddle flap, bearing on its under side a coarsely reticulated surface or mass of hexagonal yellow pores. It reaches an enormous size; clusters have been found measuring 7 feet 3 inches in circumference, and weighing 34lbs. But in cellars and other confined places, such as hollow trees, it often assumes a widely different form. In such cases it is usually the stem alone that is developed, although sometimes

there is an attempt at the formation of a pileus in patches. The stems may remain single, forming therefore a tuft of horn-like growths, blackish at the base, and yellow towards the points; but they may also branch, and this repeatedly, so as to resemble coral, or may give off lateral branches, and thus assume the likeness of the antlers of a deer. A beautiful instance of this was figured in Bolton's "Funguses growing about Halifax," about a hundred years ago, under the name of *Boletus rangiferinus* (pl. 138); and another, two feet high, was figured in the Philosophical Transactions by Professor John Martyn (vol. 43, pl. 2, f. 1). The one of which a figure is given above was sent to the Birmingham Natural History Society by R. S. Bartleet, Esq., J.P., of Redditch; it grew on a block of elm wood which has been for several years fixed in the floor of a rather damp room in his factory. It belongs to the unbranched form, and the whole tuft, which was about seven inches high, sprung from a crack in the wood less than half an inch in width.

Mr. Bagnall informs me that some years ago he received from Mr. Charles Parsons a beautiful specimen of *Polyporus squamosus*, found in a wine cellar at Edgbaston, similar to that figured by Bolton under the name of *Boletus rangiferinus*. This had a dark coloured base about six inches wide, and from this arose a number of clavaria-like processes, some of which were branched. These clavaria-like branches were from three to six inches long, and were of a pale fawn colour. A smaller example of this was also sent from a warehouse in Birmingham; this was found growing on the rafters on taking up a portion of the floor for repairs. He also received from Mr. Parsons what was probably a state of *Lentinus lepideus*. In this case the stem only appeared to have been developed, and had assumed the form of a delicate semi-transparent shell; it was about six inches long, and pearly white in colour. This was also found growing in a wine cellar at Edgbaston.

ON KEW GARDENS AND SOME OF THE BOTANICAL STATISTICS OF THE BRITISH POSSESSIONS.

BY J. G. BAKER, F.R.S., F.L.S.

(Continued from page 214.)

And think of these things, too, from a social and political point of view. Side by side with this growth in population,

and this wonderful revolution that has been brought about by railways, and steamships, and telegraphs, how we have been growing gradually more and more luxurious in our habits of daily life, and how the spread of education and the popularisation of art, and the enormous increase that has taken place in the last generation in the number of those who possess incomes of moderate competence, have increased the quantity and quality of the things which as a nation we consider that we need to enable us to live our daily lives in contentment and comfort; and how that now more than ever the mass of the nation will have an influence in making the laws and controlling the great issues of our national, foreign, and colonial policy.

Reflect upon the melancholy testimony borne also by the historic record; how, through man's greediness, improvidence, and quarrelsomeness, many of the countries which supported the great nations of antiquity have been robbed of their natural beauty and fertility. Pass round the basin of the Mediterranean and compare the state of things now with what it once was, in Persia, in the valleys of the Euphrates and Tigris, in Syria, Palestine, Asia Minor, and Greece, in Northern Africa, in Cyprus and Sicily, and, in a lesser degree, in Spain and Italy. Everywhere we find the same sad contrast of wide tracts of country that were once fertile corn-land now changed to sandy deserts and pestilential marshes; aqueducts and roads ruined by neglect and violence; vineyards and olive gardens, and groves of date palms, ruthlessly destroyed, and mountains that once were sheltered by groves of oak and pine and chestnut changed to bare stony ridges, of which the water-springs have been dried up and the grassy sward parched away, and the coating of alluvial soil which the roots of the trees kept in its place carried away by the rain to silt up the rivers and harbours of the lowlands. Contrast the Carthage of Regulus and Scipio Africanus with the Tunis of to-day; or the Cyprus that was ruled by the Venetians, when the island maintained a population of one million, to the Cyprus which was handed over a few years ago by the 'Turks' to the English, when the population had sunk to 140,000; or the Lebanon of to-day with the Lebanon of Hiram and Solomon; or the Assyria of to-day with the Nineveh of Jonah, Sennacherib, and Asurbanipal; or the Babylonian plain as it is now with what it was in the days of Nebuchadnezzar and Belshazzar.

We are told by Herodotus that the walls of Babylon were a square fifty miles in circumference, and that the Babylonian territory supported, not only its own resident population, but

also the whole retinue and army of the Persian king for four months in the year; that one of the Satraps owned 16,800 horses, and that his dogs were so numerous that four large villages were excused from all other taxes on condition of supplying them with food. He says that the soil of the Babylonian plain was so fertile that of wheat it yielded a return of two or three hundredfold, that millet and sesamum grew to a great size, and that over the whole plain the date palm flourished, bearing fruit abundantly. Now for centuries the plain has been a sandy desert, without any regularly-settled inhabitants, and the visitor sees only a few Arab tents and frail reed-huts, furnishing an impressive contrast to the ruins of the great walls and temples; the only trees now a few willows and tamarisks along the river, and here and there a spiny acacia scattered over the sand.

RECENT CHANGES IN AREA OF GROWTH OF COMMON ECONOMIC PLANTS.

About the plants that have been cultivated for many centuries, such as the vine and the hop, the cereal grasses and the common fruits and timber trees of the north temperate zone, the farmers, gardeners, and foresters, who have been working at them for generations under every phase of growth and every modification of soil and climate know far more about their different varieties and the situations they need in order to be grown successfully than botanists, whose attention is not concentrated upon the plants which are specially valuable from an economic point of view, which do not number more than perhaps one hundred species out of the one hundred thousand with which the botanist has to deal. But even of most of these during the last generation, as population has increased and the carrying trade has been completely revolutionised by steam and electricity, the countries in which they are grown have been changed very materially. The total amount of foreign food imported into Great Britain in 1864 was an average of twenty-five shillings per head. In 1883 it amounted to sixty-nine shillings per head, the difference representing a lump sum of seventy-seven millions of pounds per annum. In 1864 the total amount of foreign grain and flour imported into the country was worth twenty millions of pounds sterling. In 1883 it cost seventy millions, an increase of fifty millions in twenty years.

Before the war of secession in the United States, the Southern States had almost a monopoly of the trade in raw

cotton. Last year the value of the raw cotton exported from India was between fourteen and fifteen millions of pounds sterling. In 1840 China had a monopoly of the tea trade. In 1883-4 the value of the tea exported from India was 408 lakhs of rupees, or over four millions of pounds sterling. In 1850 the area under cultivation for tea in India was not more than a thousand acres, yielding an annual crop of 250,000 pounds. In 1880 the area under cultivation was 206,700 acres, yielding an annual crop of forty millions of pounds, representing an invested capital of £15,000,000, an annual expenditure of two millions in wages, and, at the rate of five to an acre, yielding means of subsistence for over a million natives. The annual export of coffee from Ceylon, instead of being as it was in the years between 1865 and 1878, five millions sterling a-year, has now dropped to a million and a half.

THE RECENT HISTORY OF A TROPICAL COLONY.

Take a tropical colony like Ceylon, and study how all the conditions of life there are revolutionised by the entrance of the irrepressible Anglo-Saxon. In 1837, when coffee-planting was started, Ceylon was a mere military dependency, with an annual revenue amounting to £372,000, or less than the expenditure, costing the mother country a good round sum every year, the total population not exceeding one million and a half, but requiring nearly 6,000 British and native troops to keep the peace. Now we have the population increased to two millions and three quarters, with only 1,200 troops, all paid for out of an annual revenue which exceeds £1,300,000; a people far better fed, educated and cared for in every way. The total export and import trade since planting began, has expanded from half a million sterling to eight or ten millions, according to the harvest. During the forty-five years referred to some thirty or forty million of pounds have been paid away in wages earned in connection with the plantation to Kandyan axe-men, Tamil coolies, Singhalese carpenters, domestic servants, and carters. Over 200,000 Tamil coolies were saved from starvation in Ceylon in the Madras famine in 1877-78.

According to official papers there are more than sixteen million of people in Southern India, whose annual earnings, taking grain and rice at its full value, do not average per family of five more than £3 12s. a-year, or about a half-penny a-head per day. In Ceylon each family can earn from nine shillings to twelve shillings a-week and save half or

three-quarters of that amount. Our calculation is that from each acre of coffee or tea land kept in full cultivation five natives (men, women, and children), derive their means of subsistence. It is no wonder that with a population nearly doubled during the planting era, four or five times the quantity of cotton cloth is consumed, and ten times the former quantity of food is imported into the island.*

HOW A BOTANIC GARDEN CAN HELP THE COLONIES.

It is in selecting the plants for new colonies or old ones that have been ruined by neglect, or in helping to bring into cultivation plants valuable economically that run the risk of being exterminated in their native localities, that the help and advice of a botanic garden is required, particularly for the correct identification of the best species. Take for instance cinchona, india-rubber, and gutta percha.

CINCHONA.—In temperate climates quinine is one of the most useful of drugs, and in tropical climates it is now used universally in curing and warding off fever. Quinine and its allied alkaloids are the product of the bark of trees of the genus *Cinchona*, which is restricted in a wild state to a narrow belt of the Andes of South America at an elevation of between 2,000 and 8,000 feet above sea level, particularly along their eastern declivities, from latitude 19° S. in Bolivia to latitude 10° N. in Venezuela. Here of course they are very difficult of access, and they are getting destroyed rapidly, *C. succirubra* for instance, which was found formerly in all the valleys that open on the plain of Guyaquil, is now almost confined to the western slopes of Mount Chimborazo.

In 1860 an expedition was sent out under Mr. Clements Markham, to the Andes, to procure living plants and seeds for conveyance to India, and, after many adventures and disappointments, its efforts were crowned with success. There are in the genus about thirty-six species, differing from one another in their climatic constitution, and still more in their economic value; but they are very difficult of botanical determination, because the primary types are linked to one another by puzzling intermediate forms.

The Dutch sent out an expedition to the Andes under Hasskarl in 1854, but unfortunately a large proportion of the plants which they obtained proved to belong to *C. Pahudiana*, a species of very small medicinal value. In the Indian plantations four distinct species have been planted

* "Ceylon," by W. Ferguson, F.L.S., pp. 83, 84.

extensively:—1. *C. succirubra*, which yields the red bark of commerce, yielding about 5 per cent. of alkaloids, quinine and cinchonine in almost equal proportions, which thrives at a lower elevation than the three others, but it is specially sensitive to frost, and long-continued drought; 2. *C. micrantha*, which yields the grey or silver bark, also poor in quinine, but rich in cinchonine; 3. *C. Calisaya* and its variety, *Ledgeriana*, which yields the royal, called also the yellow or Calisaya bark, the richest of all in alkaloids, of which quinine forms half or three-quarters (not less than 2, and in exceptional cases as much as 10 per cent. of quinine); and 4. *C. officinalis*, which yields the pale, or loxa, or crown bark, containing $\frac{1}{2}$ to 1 per cent. alkaloids, of which more than half is quinine.

(To be continued.)

Wayside Notes.

LEAFING OF OAK AND ASH.—The continuous and welcome sunny days of the end of May induced an unusually rapid development of the foliage of both oak and ash, so that the relative opening was not so marked as in any year during the last six or seven seasons. A large number of trees were carefully observed in S. Beds. and N. Herts., especially where they were growing in company, and in the great majority of cases oaks were before the ashes; it was only exceptional, possibly ten per cent., where the reverse was the case. Bearing in mind the constitutional differences of individual trees, I see no reason for reversing the opinion before expressed in the "Midland Naturalist," that oak trees as a whole leaf before the ash trees.—J. SAUNDERS, Luton. June, 1888.

P.S.—It is worthy of note, as bearing upon the old adage, that this season, in which the ash trees were more nearly synchronous with the oaks than usual, has been followed by a remarkably wet summer.—J. S. August, 1888.

FRESHWATER ALGÆ.—This beautiful and interesting class of plants is not as much studied as it deserves to be. It offers an ample field for discovery to any one with a microscope and good eyesight. The Council of the Leicester Literary and Philosophical Society have recently purchased the splendid collection of Mr. F. Bates, of Leicester, comprising nearly 1,800 microscopic slides, mostly prepared by himself, with admirable skill, and representing about 399 British and 19 foreign species. A number of the British species, supposed to be about 60, are not yet identified or named. The Council are anxious that this fine collection should be turned to account for the general benefit of science, and if any student desires to make use of them, an application to that effect would be favourably considered.

Bristol Hill, Leicester.

F. T. MOTT.

BOTANICAL NOTES FROM SOUTH BEDS,
WITH VOUCHER SPECIMENS.

| NAME. | DATE. 1888. | ASPECT. | SITUATION, &c. |
|-----------------------------------|----------------|---------|---|
| <i>Corylus avellana</i> | Jan. 29 | N. | Hill top, both sexes of flowers open. |
| <i>Mercurialis perennis</i> .. | Feb. 12 | S. | Bank, foliage and <i>buds</i> only. |
| <i>Tussilago Farfara</i> ... | Mar. 3 | S. | G. N. R., several blossoms. |
| <i>Petasites vulgaris</i> | „ 4 | Open. | Boggy meadow, one spike only, which was nipped by frost. See below. |
| <i>Mercurialis perennis</i> .. | „ 25 | S. | Hedge bank. |
| <i>Cardamine hirsuta</i> | „ 30 | S.W. | Side of a brook. |
| <i>Ranunculus Ficaria</i> .. | „ 30 | Open. | Boggy meadow. |
| <i>Petasites vulgaris</i> | „ 30 | „ | Plants not generally in blossom till about this date. See above. |
| <i>Helleborus viridis</i> | April 1 | „ | Meadow, numerous blossoms. |
| <i>Salix capræa</i> | „ 7 | W. | Coppice. |
| <i>Caltha palustris</i> | „ 13 | Open. | Moist meadow. |
| <i>Ulmus montana</i> | „ 15 | „ | |
| <i>Anemone nemorosa</i> .. | „ 15 | „ | Coppice. |
| <i>Poten. Fragariastrum</i> .. | „ 15 | W. | Bank. |
| <i>Primula veris</i> | „ 21 | S.E. | Hill side. |
| <i>Nepeta Glechoma</i> | „ 28 | Open. | Rough ground. |
| <i>Prunus spinosa</i> | „ 29 | „ | Hedge, only a few flowers open. |
| <i>Adoxa Moschatellina</i> .. | May 6 | N.W. | Bank. |
| <i>Ranunculus bulbosus</i> .. | „ 9 | S.E. | Pasture. |
| <i>Stellaria Holostea</i> | „ 12 | W. | Bank, plentiful. |
| <i>Sisymbrium Alliaria</i> .. | „ 12 | „ | Do. do. |
| <i>Cardamine pratensis</i> .. | „ 12 | Open. | Meadow, plentiful. |
| <i>Scilla nutans</i> | „ 13 | N.E. | Bank. |
| <i>Viola Riviniana</i> | „ 13 | W. | Bank. |
| <i>Geranium Robertianum</i> | „ 21 | S.W. | Hedge bank. |
| <i>Vicia sepium</i> | „ 21 | „ | Do. do. |
| <i>Cratægus monogyna</i> .. | „ 31 | „ | Do. do. |

The excessive cold of the early months of this year rendered the records very meagre till near the end of March. Dog's Mercury, March 25th, I have known in blossom by the first of January; Colts-foot, dated March 3rd, has been in blossom late in January in the same station, which has been under observation for six or seven years; while Butterbur, which showed one blossom March 4th, was retarded by frost for quite another fortnight. Barren Strawberry, sometimes gathered in January, was searched for carefully, but was not observed till April 15th.—J. SAUNDERS, Luton.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—**SOCIOLOGICAL SECTION**, July 28th. The eleventh half-yearly field meeting of the section was held at Evesham. The members (numbering sixteen) assembled at New Street Station at 1.50, and took train to Evesham, where they were joined by Miss Gingell, Mr. Slatter, Mr. Cullis, and Mr. F. Hughes, making the number up to twenty. Notwithstanding the rain which descended in a continuous downpour, the party, conducted by Mr. Slatter, walked through the town, and inspected the Parish Room, the two Chapels of All Saints and St. Lawrence, the Cloister Arch, and the Bell Tower. This last is a magnificent campanile, built by Clement Lichfield, the last real abbot of Evesham. It is one of the finest examples of late Gothic architecture now extant, and is in an excellent state of preservation. From the abbey the section proceeded to the residence of Mr. Slatter, and examined his extensive and valuable collection from the inferior oolite; and from thence repaired to the hotel, where tea was provided. At six o'clock the chair was taken by the President, Mr. W. R. Hughes, F.L.S., who, after welcoming the visitors, read a letter from Mr. Herbert Spencer, inquiring after the welfare of a society established for the study of Sociology in Paris by M. Grosclande, C.E., and enclosed a communication from Mr. Skelton, of Brooklyn, U.S., announcing the opening of a society there, on similar lines, in connection with the second Unitarian Church of Brooklyn. The President then called upon Mr. Howard Pearson to read his paper on "Simon de Montfort." Mr. Pearson, who was cordially greeted on rising, after tracing the origin and history of the Montforts, said that Simon was one of the fathers of our constitutional liberty who had done great and lasting service to the English people, and who was not recognised according to his deserts. He was the one man of his age who understood the spirit of the English nation, yet he was passed over, by those who neither knew nor cared to whom they owed their liberty of speech, as a foreigner who failed. In 1258, when the vacillation and weakness of Henry III. had brought the people almost to a state of rebellion, a parliament was called, meeting at Oxford, from which issued the famous provisions of Oxford, by which the government was placed in the hands of a council. Twelve representatives of the Commons were to be called to the parliament, which was to meet three times a year, "summoned or not." Later on, at the period when Henry and Prince Edward were prisoners of Simon de Montfort, he took the momentous step of admitting the Commons to a still larger share in the government of the country, and summoned each town to choose and return two burgesses to be their representatives, which still abides the unalterable basis of our liberties. He was idolised by the Commons, revered by the Church, and held as a saint. His friends were passionately devoted to him, and amongst the little band which preferred to meet death rather than live without him, we have pride in numbering William, Lord of Birmingham. At the conclusion of Mr. Pearson's paper, the President called upon Mr. Slatter, who gave an address on "The Geology of the Vale of Evesham," tracing the succession of the strata, and giving an account of their characteristic fossils, and their relation to the physical geography of the neighbourhood. A vote of thanks to Mr. Howard Pearson for his admirable paper, proposed by Mr. A. Browett and seconded by Mr. Chase, and a vote of thanks to Mr. Slatter for his interesting and instructive address, and for his courtesy in conducting the party and permitting

them to examine his collection, proposed by Mr. J. H. Lloyd, and seconded by Dr. Showell Rodgers, were both carried unanimously.—**BIOLOGICAL SECTION, July 31st.** Mr. F. Goode in the chair. The following were exhibited:—By Mr. F. Goode, *Cytisus laburnum*, in flower and fruit; by Mr. Bolton, for Mr. W. R. Hughes, F.L.S., a fine collection of polyzoa from Evesham; Mr. W. H. Wilkinson, lichens from Northampton Excursion, amongst which were *Lecidea albo-atra*, *Calicium hyperellum*, *Usnea rubiginosa*, &c.; by Mr. J. E. Bagnall, for Rev. T. Norris, a fine collection of rare plants from Loddington Wood, Leicestershire, amongst which were *Vicia sylvatica*, *Agrimonia odorata*, *Lathyrus sylvestris*; for Mr. J. B. Stone, F.L.S., flowering plants and mosses, from St. Bernard and Interlacken, the more rare being *Anemone sulphurea*, *Dryas octopetala*, and *Neckera cripa* in fruit; for Rev. D. C. O. Adams, fungi, *Agaricus cervinus*, *Ag. rivulosus*, *Russula depallens*, from Ansty, near Coventry.—**MICROSCOPICAL SECTION, August 7th.** Mr. R. W. Chase in the chair. Mr. Marshall exhibited a specimen he had just brought from Norway of *Cotula coronopifolia*, a marsh plant of the composite order that was stated to be not found in any other country of Europe, and in only one locality in Norway. Also, the skin of a fish from Norway, having a brilliant blue colour, which was identified by Mr. Hughes and Mr. Chase as *Labrus bergylta*, the Ballan Wrasse, occasionally found on some parts of the coast in this country. Mr. Chase gave an account of an excursion he had just made to the East Coast, where he had been extremely fortunate from an ornithological point of view.—**BIOLOGICAL SECTION, August 14th.** Mr. R. W. Chase in the chair. Mr. W. B. Grove, B.A., gave a full and interesting account of his recent visit to Staffa, Fingal's Cave, Lewis, and other of the Western Isles, and exhibited a rare fungus, *Lachnella Rhytismæ*, from Lady Matheson's grounds, Lewis; he also exhibited the following fungi from Sutton: *Agaricus acute-squamosus*, *Peziza omphalodes*, *Leocarpus fragilis*, &c. Mr. J. Levick also gave additional notes of a tour in the Hebrides, and exhibited as part of the spoils, *Drosera anglica*, *Saxifraga aizoides*, and *Sphagnum contortum*. Mr. C. Pumphrey exhibited a fine specimen of the bladder nut, *Physalis Alkekengi*. Mr. J. E. Bagnall, A.L.S., exhibited *Gymnostomum rostellatum*, from Alcester, new to Warwickshire, and *Physcomitrella patens*, new to South Warwickshire, from Alcester and Wormleighton; also, for Mr. J. B. Stone, a number of rare mosses from the Swiss Alps, including *Cylindrothecium cladorrhizans*, *Barbula mucronifolia*, *Orthotrichum rupestre*, &c.; for Mr. C. Pumphrey, mosses collected during his visit to Norway, amongst which were *Tetraplodon mnioides*, *Hypnum loreum*; also *Jungermannia saxicola*; and for Miss Gingell, a large collection of rare and local plants, from Dursley, Gloucestershire, such as *Geranium columbinum*, *Aquilegia vulgaris*, *Melica uniflora*, and a series of specimens of *Paris quadrifolia*, having four, five, and six leaves in a whorl, giving also notes on their distribution, economic uses, and folk lore.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—July 23rd. Mr. P. T. Deakin exhibited a collection of land and fresh water shells from Hampshire, including specimens of *Balea perversa*, also a collection of fossil leaves from the Eocene beds of the same district; Mr. J. Madison, wing of a neuropterous insect, from the Rhaetic beds of Knowle; Mr. Corbet, slabs showing impressions of rain drops and ripple marks from the same formation. Mr. O. Hutchinson then read a paper on "The Green Slime, *Protococcus*." An examination of this object would show it to consist of a vast

number of green bodies from $\frac{1}{3500}$ to $\frac{1}{4000}$ of an inch in diameter. Its multiplication was very simple. The cells became elongated and depressed in the middle, a septum dividing them into two; this was crossed at a right angle by another septum dividing them into three or four cells. Its mode of reproduction showed it to have been probably an aquatic plant. Its food was taken from rain water, and sunlight was necessary for its development. The motile and immotile forms were spoken of as bearing a strong resemblance to some low forms of animal life. The paper concluded by referring to the profit and pleasure of tracing out the life history of any common form of alga or fungus.—July 30th. Mr. J. Madison exhibited a specimen of *Helix aspersa* var. *temis*, from Guernsey; under the microscope, Mr. J. W. Neville, parasite of *Limax flavus*; Mr. Rodgers, *Volvox globator*, from a tank in which he had kept it for three years.—August 13th. Mr. H. Hawkes exhibited the following fungi from Hamstead Park:—*Pannus conchatus*, *Polyporus squamosus*, *Diachæa elegans*, *Craterium minutum*, and *Diderma vernicosum*; Mr. J. Madison, *Helix aspersa* var. *minor* and *H. virgata* var. *subalbida* and *albicans*; Mr. J. Collins, *Spiræa filipendula*, *Crithmum maritimum* and other plants from Somersetshire; under the microscopes, Mr. W. Dunn, *Melicerta ringens*; Mr. Collins, *Ceramium acanthonotum*.

DUDLEY GEOLOGICAL SOCIETY AND FIELD CLUB.—

This Society held a Field Meeting on Wednesday, the 22nd inst., at Ankerdine Hill, Knightwick, on the Worcester and Bromyard line of railway. This hill, though not at all lofty, is considered the most picturesque hill in Worcestershire, commanding very extensive views in every direction, and as the day was very clear, the party were much delighted with the prospect, which included the Malverns, which show up grandly in their massiveness from this point; the Abberley range, the Titterstone and Brown Clees, Clent and the Lickey, Bredon and the Cotteswolds, with a distant view of the Sugar Loaf and Black Mountain. The hill is mainly composed of Upper Llandovery beds, which, being on the axial line of disturbance of the Malvern and Abberley Hills, are much dislocated and faulted against rocks of several later formations. Some of the bands are very fossiliferous, and contain innumerable casts of *Atrypa hemispherica*, and the delicate worm-tube, *Tentaculites annulatus*; but as the matrix is a rather coarse and loose sandstone, the specimens are very unsatisfactory. The botany of the neighbourhood is especially rich and varied, and, among the more rare species of plants met with, the following were determined by the Rev. J. H. Thompson and Dr. Fraser:—*Vicia gracilis*, *Hieracium murorum*, *Hypericum Androsæmum*, *Erythræa Centaurium* var. *flore albo*, *Cardamine impatiens*, *Geranium pusillum*, *Geranium dissectum*, *Conium maculatum*, *Malachium aquaticum*, *Sison Amomum*, *Origanum vulgare*, *Potentilla argentea*, *Matricaria Chamomilla*, *Pimpinella Saxifraga*, *Rhamnus catharticus*, *Cerasus austera*, *Poa nemoralis*, *Brachypodium sylvaticum*. In the course of the day the President, Mr. Horace Pearce, F.L.S., F.G.S., exhibited the following rare plants:—*Verbascum Lychnitis*, *Nasturtium amphibium*, and *Lythrum Salicaria*, from Whittington; *Sedum Rhodiola*, in fruit, from Snowdon; *Erica vagans*, from The Lizard, Cornwall; *Erodium maritimum*, from Habberley Valley; and *Tragopogon pratensis*, from lane, near Stourbridge. Mr. W. Madeley also exhibited a fine flint celt (*Palæolithic*), and two scrapers from river, Maidstone, of which he guaranteed the genuineness. The Society will hold a half-day meeting at Pouk Hill, Walsall, on Saturday, the 1st September, for the purpose of examining the Trap

rock, which is so well seen there, intruding into the coal measures, and charring the coal till it becomes a hard coke. The last meeting will take place on the 18th September, at Rock, near Bewdley.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.—SECTION D, ZOOLOGY AND BOTANY. Chairman, Mr. F. T. Mott, F.R.G.S. Evening Meeting, Wednesday, July 25th; attendance, nine. The Chairman exhibited a simple apparatus of wood marked with scales of inches and fractions for measuring the daily growth of plants. A discussion ensued as to the effect of light upon vegetable growth. Dr. Finch stated, on the authority of Sachs, that the shaded side of herbaceous stems grew faster than the sunny side, and that this was the cause of heliotropism. The subject is very complex, and offers a wide field for research. Mr. Palmer exhibited shells of *Planorbis corneus* and *P. carinatus*; Mr. Carter specimens of *Cardamine impatiens*, which had appeared as a casual in a garden at Stoneygate; Dr. Finch, specimens of *Viola lactea*, from Hampshire; the Chairman, a number of garden flowers with their foliage. The Chairman read a short paper "On the Results of Cultivation," showing that cultivation imparted no new faculty, but was simply an unfolding of hidden potentialities; that the cultivator supplied the conditions necessary for the development of some special tendency already existing in the plant, and that by supplying or withholding such conditions he could develop almost any part of the plant at will; that civilisation was impossible without cultivation, because vegetable as well as animal food was essential to civilisation, and nature provided vegetable food suitable for man only at certain seasons and in small quantities; and that most of our vegetable foods were, in fact, artificial productions.

SEVERN VALLEY NATURALISTS' FIELD CLUB.—The third Field Meeting of the season was held at Stokesay and Hopesay, on Tuesday, August 7th, and was attended by about thirty members. At Stokesay Castle the club was met by the Rev. J. D. La Touche, President of the Caradoc Field Club, who gave an interesting account of the structure and history of the building. After visiting the church, the club followed their guide to the slope below Yeo Edge, where Mr. La Touche sketched the solid geology of the district, with special reference to the origin of the Stokesay Valley, which cut across the strike of the Silurian rocks, the escarpments of Aymestry limestone facing each other on opposite sides. He also touched upon the history of the region in the glacial epoch. Dr. Callaway, President of the Severn Valley Club, followed with remarks upon the relations to each other of the older Palæozoic formations on each side of the great Church Stretton fault. He then outlined the recent views of the late Prof. Carvill Lewis, of Philadelphia, who held that in the glacial period a great ice-sheet flowed down the Irish Sea, sending a tongue across the plain of Cheshire to North Shropshire, where the ice terminated, and moraines and morainic lakes were formed. The club then took train to Broome, and, by the kindness of J. T. Barber, Esq., were conveyed in carriages to Hopesay, where they visited the encampment of the Hill of Barrow under Mr. Barber's guidance, and were afterwards hospitably entertained at a sumptuous tea by the Rev. R. G. Maul, the rector. The fineness of the weather, the interest of the geology, and the kindness of their guides and hosts, made the visit of the club most pleasant and instructive. The advantages enjoyed were largely due to the energy and influence of the Hon. Secretary, the Rev. R. C. Wanstall, R.D.

INSULARITY.

BY THE REV. H. H. SLATER.

(Continued from page 220.)

I hardly know to what to attribute this scientific insularity. Perhaps to the in-bred Conservatism with which most Englishmen are so profoundly imbued—however much they might be inclined to resent the imputation from a political point of view. But it says very little for us as a scientific nation, if we have not been able to emancipate ourselves from the trammels under which Gilbert White was compelled to study the natural history of Selborne a hundred years ago—if the times have marched, and foreign nations have marched with them, but our “scientific frontier” remains where it was.

And, when we come to look at the question in all its bearings, we must see what advantages we have over the rest of the world. Our scientific horizon might have been expected to have been such a broad and wide one. For we have colonies dotted all over the world, and countrymen resident in every part of the globe. On British soil the sun never sets. We might make our expatriated countrymen such numerous and useful contributors to our scientific knowledge, it might be thought, but in how wofully few cases is this a reality! It is a saddening reflection, but I am afraid we cannot gainsay its truth, that an Englishman stationed abroad lands at his destination with a fixed resolve to imagine, by a species of conventional fiction, that he is still resident at home. Excepting as far as his changed surroundings minister to his tastes from a strictly sporting point of view, his main object in his spare time seems to be to maintain a little England about him. As a rule he ignores the natives, except from the point of view of a political, commercial, or sporting adjunct, and his life abroad appears to bespeak his feelings thus:—“I am obliged to be out here on account of my profession or business, but I wish it to be distinctly understood that I had much rather be at home; and life here will only be so far endurable, as I can approximate it to that I have left behind me in England; I will therefore jealously stick to my tennis lawn, my cricket ground, and my race meeting, and I will have my polo and pic-nics and dinner parties after the British pattern. The country may be pretty enough, but I must have something to *do*.”

And I have learnt to take an interest in so few things in this world (and those, we might add, such essentially artificial things) that I must go on to the end of the chapter in the selfsame groove in which I have hitherto been moving."

And so he stays out his allotted time, scorns the "niggers" by whom he is surrounded, cares nothing for, and learns very little of, the country in which he is domiciled, except, to take an example, the current value of the rupee, and the mad delight of pig-sticking, and comes back with a liver and an income large enough to enable him to go on leading the rest of his natural life on the same lines at home, and knowing far less of the natural features of the country than we might know ourselves without ever leaving England.

But are not we, "who live at home at ease," as the saying is, partly to blame for this state of things? Ought we not, when we send a son from our homes to the other side of the world, to have taken care beforehand that he should not be forced, in the absence of congenial and well-bred English society, to take his only delight in pleasures of the senses? Is it not partly our fault if he come back to England very much as he went out, a "returned empty." I think we owe it to those over whom we have influence—knowing from our own experience the civilising and tranquilising influence of the particular tastes we ourselves affect—to do our best, as a personal duty, to see that they shall not incur the danger (and it is a great danger) of being thrown upon their resources in a foreign land, without being able to reckon amongst those resources at least one wholesome and intellectual pursuit—especially as public opinion in these days has been graciously pleased to smile more upon scientific pursuits, instead of stigmatising their possessor as a "bug-hunter," or a "feller who is cracked about birds' eggs." How many English officers abroad would have found a taste for natural history—if they had only had it—a perfect godsend to them, and a satisfying of a want which billiards, and polo, and "pegs," and parades do not adequately fill!

And apart from this philanthropic view of the case, it is impossible to calculate the value to science of the labours even of the mere collector, in the shape of duly authenticated and localised specimens. And more than this, how many more opportunities might we ourselves, who, from the force of circumstances, are unable to pursue our studies in any distant part of the world, have made for ourselves for doing a little original work, if we had utilised our friends abroad more—if we had inspired them with the taste, and extracted from them a promise to look out for birds, or plants, or

insects, or fossils (according to what we are mainly interested in), and prepared them for the species which would be most likely to repay collecting, and the sort of places where they were most likely to be found. I think that an arrangement of this description would strongly resemble Shakespeare's description of the "quality of mercy," in this respect, "that it would be twice blessed—it blesses him that gives and him that takes."

I am inclined to regard it as a somewhat unpromising sign of the times, that so many manuals on the British Fauna and Flora are being issued at present. No doubt they have a use—and a very important use, though a limited one—they are of the greatest assistance to the beginners. In the hands of young students a reliable manual of the British representatives of the study of his choice forms a very desirable framework on which to base his future investigations. But with how large a number of persons is not the extent of scientific knowledge (if it can be called such) as comprised in a British manual their be-all, and end-all? Surely this is an unsatisfactory state of things. We all want a general knowledge as a foundation, but, that once gained, our next object surely should be, to become a specialist. In other words, as we are not, most of us, professional scientific men, and perhaps unfitted therefore to become leading lights in any one entire branch of natural history, we should try nevertheless to master completely some minor section of one branch of science, so as to benefit that science, as a whole, by our contributions to the knowledge of one of its parts.

I do not think that we amateur naturalists keep a sufficiently lofty ideal before our minds. It is well to derive amusement and recreation from our scientific pursuits, but should we not look higher than this? Science will, perhaps, put nothing in our pockets, but what of that? Is nothing worthy of real work which will not return so much per cent.? I think we should aim at being of use to our science in our degree—aim at adding our quota, though it be a humble one, to the general sum of knowledge, as far as our other avocations permit—to be, in short, scientific worker bees, not merely drones. And it is a question for ourselves to settle whether we are ever likely to do anything worth the doing, except by the merest chance, by going over and over again the same beggarly elements, where so many others have been before us, with the sole aid of never so excellent a British manual.

I am not sure that another feature of the scientific literature of the day, the large and increasing number of

county manuals—of birds, &c.—does not partly point in the same direction. I am referring chiefly to local ornithological manuals. These are mostly written—though there are notable exceptions—by ornithologists of mark, and with great ability, and are valuable contributions to knowledge, as far as they go. They are also, with the exceptions I have alluded to, an element which no writer on general ornithology would dream of disregarding, but from which he would receive valuable hints on the question of distribution. But writers on general ornithology are not numerous—and the copies which are published are—and where do they all go to? Whose hands do they fall into? Into the hands of those, I am afraid, to a great extent, who are either resident in the county or personally interested in it, and who want to know, or who think they ought to know, a little of the local birds—but not much—and who see in a county manual, and in the artificial boundaries of the county itself, a convenient dividing line between the amount of knowledge which it is worth while contemplating the distant acquisition of, and the wider field of general ornithological study, in which they have no ambition to be explorers, and which they mean to disregard.

And speaking of ornithology, I am afraid that it is partly made, owing to its present popularity, a kind of literary stalking-horse, a sort of peg to hang another sort of literary ventures on. In some of the magazines and periodicals which are devoted to light articles on general literature, and occasionally in the daily papers, there are occasional articles on natural history subjects (or, at all events, taking a natural history text), many of which would never, perhaps, have been written but for the popularity of the late Mr. Richard Jefferies, the able author of “The Gamekeeper at Home,” and a number of like works. But the magazine articles of which I am speaking are written without the close observation of the gentleman I have named, and they mostly select what may be termed the romantic side of natural history, and it is doubtful whether they are of real benefit to any but the writer. They are little else than specimens of the prevalent disease (shall I call it?) of fine writing, of which the modern novel is the chief seat, and it is in the last degree unfortunate that natural history subjects should be selected as the theatre for such displays. “It is magnificent,” a foreign gentleman of some celebrity said of the charge of Balaklava, “but it is not war.” In the same way, we may say of these articles, and of the books into which they occasionally expand, “they are all very pretty, but they are not natural

history." Reverent students of nature as she is will only be grieved to see sentimentalism imported into their favourite study.

We naturalists have another foe, who similarly desires to pass himself off under the guise of a brother, when he is nothing of the sort. I allude to the person who is a collector, and a collector only—not a student of nature—not one whose aim it is to make his collection when made an only more accurate book to read. I am not now speaking of the dealer, who is earning his living by the collection of specimens to be resold to those who require them. There are, however, dealers and dealers. But it is not of dealers that I am speaking—some of whom I desire to mention with all respect—but of amateur collectors. A great deal of the disfavour with which ornithologists are looked upon is brought upon them by amateur sportsmen and collectors. From these the ornithologist gets a reputation for ruthlessness, which I am convinced, from a pretty extensive acquaintance with him and his ways, he by no means deserves in the main. The naturalist proper, though ready to take life if the doing so will advance what he justly considers his lawful aim, is no less humane than ordinary mortality—indeed, if any thing, more so. He conceives himself entitled, on the highest authority, to take life for a definite purpose, and his, he considers, is a high one, but he won't tread on a worm or a beetle, or flatten a spider, because he considers it to be ugly, as many will. I have been often enough in the company of gentlemen whose title to be ranked as ornithologists is beyond question, and for weeks at a time, whilst they were, as one might say, on the war-path, and though they had guns constantly in their hands, they have made very little use of them; but, on the other hand, a very great deal of use of their field glasses. Anything that was killed, was killed because it was wanted to fill up a gap in their collection of reference, and was invariably utilised. At the very same time I have heard and seen the amateur sportsman cannonading away like an animated Gatling gun, slaughtering the beautiful and harmless gulls and sea swallows by the dozen—and, indeed, anything else that would let him get near enough. They were of no use to him when he got them, especially in such numbers; indeed, these gentry rarely take the trouble to pick up what they kill, much less to be humane enough to put the wounded and maimed out of their sufferings. I have seen myself the seashore almost strewn with dead sea swallows, the day after these brutes had been about, the taking of whose lives answered no purpose whatever, and

never was meant to. But if one of these creatures does take the trouble to carry home one or two of the least soiled of his victims, and has them stuffed (as the expression is) to ornament (as it is called) his house, he arrogates to himself the title of naturalist, and no one seems to dispute his right to it.

(To be continued.)

A CHAPTER IN THE PHYSICAL GEOGRAPHY OF THE PAST.

PRESIDENTIAL ADDRESS
GIVEN TO THE BURTON-ON-TRENT NATURAL HISTORY
AND ARCHÆOLOGICAL SOCIETY.

BY HORACE T. BROWN, F.G.S., F.I.C., F.C.S.

(Continued from page 228.)

From the fault last referred to the Coal Measures occur at the surface to a little east of Burton, where they are lost sight of under the mantle of New Red Rocks which surround the Leicestershire Coalfield. These Coal Measures, as far west as we can trace them, have also been affected by the great earth movements which brought about the Charnwood axis of elevation, and show a system of faults and folds approximately parallel with this. They have also been subjected to plications and faulting at right angles to this axis, with the result that the strata of the western or more productive parts of the Coalfield have been thrown into a basin-like form, which has much conduced to their preservation. And here, perhaps, in dwelling upon this, it will be well to correct a misapprehension which has probably arisen in the minds of some of you, that elevated tracts of land are generally coincident with upward folds or ridges in the underlying rocks, whilst the valleys run in the troughs. This is undoubtedly sometimes the case, and we have seen two good instances of it in the structure of the Pennine and the Charnwood Ranges; but more frequently the very reverse holds good. When a mass of strata which has been thrown into a series of folds is planed down on its upper surface by the action of the sea, forming what is called a plain of marine denudation, it is evident that the folds which are convex upwards must be planed off before the concave portions or the troughs can be reached. Moreover, when such a plain of marine denudation becomes again dry land, and subjected to atmospheric influences, the trough and saucer-like portions of the folds, owing to the inclination of the strata towards each

other, will be more stable than the convex portions in which the strata incline outwards. In one case the force of gravity will *retard* denudation, in the other it will *facilitate* it. And thus it may, and often does come to pass that the summit of a hill is coincident with the trough of one of the folds, or the synclinal as it is called, whilst the valley runs along the anticlinal. Another reason for the difference is to be found in the frequent fracture of the tops of anticlinals allowing the freer access of water, and thus hastening the destruction of the arch.

It now becomes easier to understand what I have said about the saucer-like shape of the western portion of our Coalfield conducing to its preservation. This is a structure common to nearly all our Coalfields, and is merely a geological instance as applied to strata of the "survival of the fittest" to withstand denudation.*

Having now briefly glanced at the physical features and geological structure of the Pennine Range and of its southern extension under the newer rocks of the Central Midlands, we must try to ascertain something about the conditions under which the sediments forming the various portions of this huge pile of Carboniferous Rocks were originally deposited. But before we attempt to do this let us turn for a moment to what is going on at the present day around our coasts, and see if we cannot deduce from our observations some guiding principles with regard to the phenomena of sedimentation, which may help us in our enquiry.

We find that the material which is constantly being brought down by streams and rivers, and which has of course been derived from the degradation and waste of the land, is deposited on the bottom of the sea when the velocity of the currents bringing it down has been sufficiently checked. The particles thus carried down to the ocean vary in size from large rounded pebbles to the finest possible mud; and, since

* I do not know any better instance of the comparative stability of synclinally curved strata over strata curved in the opposite direction than is shown in a portion of our coast which most of you know well. The great Orme's Head at Llandudno is a bold hill of massive Mountain Limestone connected with a smaller hill of the same rock, the Little Orme, by a very narrow neck of low-lying ground. When the two hills are seen from Llanfairfechan on the west, it can be clearly seen that the strata of the Great Orme are bent upwards in a synclinal or saucer-like form, and it is perfectly evident from the lines of the curved strata that they once bent over again in the form of an arch to the mainland, and joined those of the Little Orme. The result of denuding forces acting equally upon this once continuous mass, has been entirely to remove the comparatively weak arch or anticlinal portion, and to leave the saucer-like synclinal untouched.

the carrying power of water is dependent upon its velocity, it is not surprising that we find a sorting action going on; that whilst the coarser sediment is deposited near the coast the finer material, under the combined influence of the out-flow of rivers, and wave and tidal action of the sea, is carried out to a far greater distance from land before it is deposited on the more or less shelving bottom.

If we could make a horizontal section at right angles to the shore line of any large body of water, fed by running streams, we should find, as a general rule, a belt of coarse, roughly stratified shingle, giving place gradually to a less coarse and more sandy sediment, and this again graduating further from shore into beds of fine mud, which may extend for a very considerable distance. From the somewhat intermittent character of the streams and currents we should not expect anything like a sharp or invariable line dividing off these various sediments horizontally, but we should observe them dove-tailing, as it were, into each other laterally.

It is evident that the beds of fine mud forming the very outermost fringe of the land must come to an end somewhere, for, given a sufficient time, the very finest sediment will fall to the bottom.

As a rule, except in shallow seas and opposite the mouths of great rivers, the very finest mud deposits do not extend more than 100 miles from land. Farther out than this in deep water soundings have shown the bottom to consist of a widely spread deposit of a white sticky *ooze*, which, when dried resembles chalk in appearance and also in composition.* This is a veritable *limestone* now in course of deposition, and is the product of minute specks of living jelly, which abstract the carbonate of lime from sea water wherewith to form their shells, which, after the organisms are dead, are showered down upon the sea bottom. These microscopically minute animals are known as Foraminifera, and many of the limestones known to geologists have been built up almost entirely by their agency. They are, however, by no means the only limestone builders. Coral Polyps play a most important part in the production of modern limestones, and that they have played as important a part as far back as Devonian and Carboniferous times is equally certain. Then again we find some limestones made up almost entirely of the remains of Encrinites or sea-lilies, and of the shells of molluscs. Muddy water is absolutely inimical to the life and growth of these limestone builders, and we may be quite sure when we

* In the abyssal depths of the ocean this calcareous ooze is replaced by a red clay, the origin of which is at present unknown.

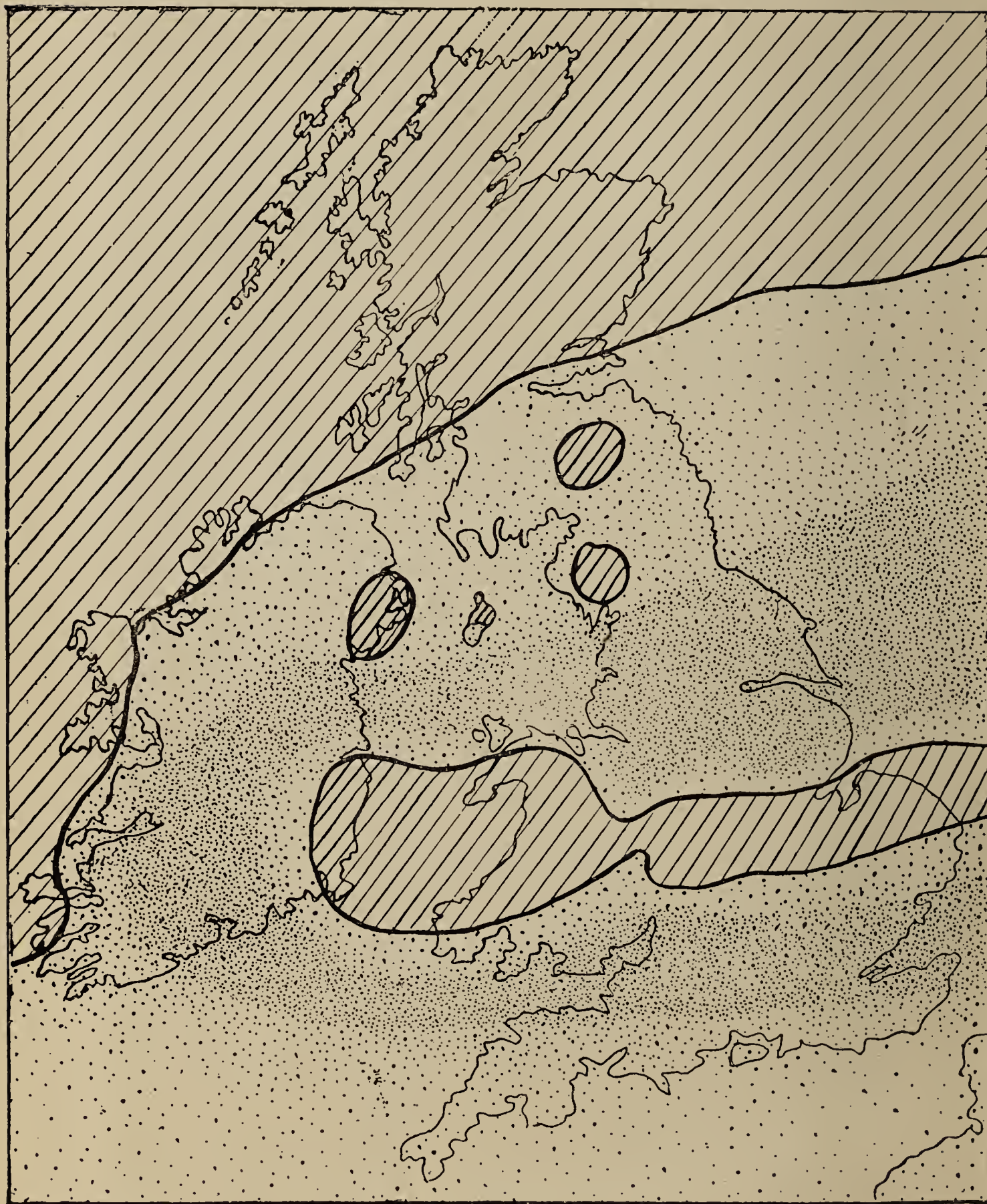
find a mass of pure or almost pure limestone of organic origin that the deposit was formed far away from land, or at any rate in water absolutely free from the influence of streams bearing their freight of mud seawards.

Such a mass of limestone is that of Central and North Derbyshire, and we are justified consequently in taking the first step in our reconstruction of the physical features of the Lower Carboniferous period, by assuming that this immensely thick mass of almost pure limestone marks the position of an area of deep and perfectly clear water.

When this mass of limestone of the Pennine Range is traced along the country to the north, we lose sight of it in the neighbourhood of Castleton, owing to its disappearance below the Yoredale Shales and Millstone Grit. When it is once more brought to the surface in the neighbourhood of Skipton, in Yorkshire, by the east and west plications already referred to, it shows some decided indications of altering its character, for we now find it containing several beds of shale, or hardened clay. Still, however, the limestone predominates, but the deposit has not quite the pure character of the limestone further south. A little further north still the shales or clays become thicker, and the limestones thinner, and, at the same time, the beds of limestone become divided by beds of *sandstone*. This progressive change continues right into Northumberland, where the massive Mountain Limestone and Yoredale Series of Derbyshire are found to be replaced by a mass of sandstones, shales, and thin limestones, containing in the upper part as many as seventeen seams of thin, but workable coal, all deposits of shallow water origin.

Now this extraordinary but gradually progressive change in the character of the beds when traced laterally, can only be satisfactorily explained in one way, when we bear in mind what we may call the physics of sedimentation. As we proceed northwards, we are leaving behind us the deep sea of Lower Carboniferous times, with its clear water and limestone-building creatures, and are approaching, through gradually shoaling water, *the old coast line, and the mouths of the rivers which brought down from the old Carboniferous land the sand and mud which now form the sedimentary deposits.*

The exact position of this old coast line is indicated by a bed which lies at the very base of the Carboniferous rocks of the North of England, but which is, of course, not met with in the Midlands. It is what is known as a Conglomerate, a rock-like mixture of sand and rounded pebbles. It is, in fact, a consolidated and fossilised sea-beach, and we find it abutting against the old shore formed by the Cheviot Hills, from which most of its rolled fragments have been derived.



 Land.
 Water.

MAP OF THE AREA, NOW OCCUPIED BY BRITISH ISLES, DURING THE
LOWER CARBONIFEROUS PERIOD.

N.B.—The relative depth of the water is indicated by the dotted shading.

Although the Cheviots formed land during early Carboniferous times, we have sufficient evidence to indicate that the area was an *island*, and that we have to look still a little further North for the coast of that great continent which was drained by the rivers of the Carboniferous period. In Lanarkshire we find the old Carboniferous beach resting upon the old Red Sandstone, and, to a great extent, derived from its waste. From the thinning out of all the beds above this, there is the strongest possible evidence that, across a line drawn from the Firth of Tay to the extreme North of the Island of Arran, the shore conditions continued for a very long period in Lower Carboniferous times, and that the land rose rapidly North of this line, in the region of the Scotch Highlands, to a much greater height than it does at the present time.

In Ireland the Carboniferous Limestone is strongly represented in Clare, Tipperary, and Queen's County, its greatest development being only about half a degree of latitude further south than its greatest development in our own Northern Midlands. Here, just as with us, the limestone shows the same tendency to give place to mechanically formed deposits, *i.e.*, sandstones and shales, further towards the north and north-west, indicating, as with us, the direction in which the old land lay. That the western portions of Donegal, and of Connaught, formed part of this coast there is a great deal of evidence to show, and it is probable that the western portion of County Kerry was also above water.

Around the old Silurian Rocks of our Lake District there are found thick uneven deposits of Conglomerate and Sandstone, belonging to the base of the Carboniferous, and, from their irregularity and the rapid way they thin out, it is evident that they were beach deposits banked around an island in the Carboniferous Sea. There are also similar deposits in the southern part of the Isle of Man.

Having traced the Mountain Limestone of the deep water of Central Derbyshire to the north and north-west shore of the sea in which it was deposited, we will retrace our steps once more to the Derbyshire district, and ascertain what becomes of this massive limestone when followed southwards.

The southern prolongation of the limestone of the Weaver Hills plunges, as we have seen, beneath the more recent New Red Measures, near Ashbourne, and we see nothing more of it until, owing to a series of small folds, it is brought to the surface again some 20 miles to the south-east on the northern margin of Charnwood Forest. We there find it in eight small patches, of which that of Ticknall is the most northerly, and that of Grace Dieu the most southerly.

(To be continued.)

ON KEW GARDENS AND SOME OF THE BOTANICAL
STATISTICS OF THE BRITISH POSSESSIONS.

BY J. G. BAKER, F.R.S., F.L.S.

(Continued from page 235.)

In India the product of the bark is used mainly in the form of a mixed febrifuge in which the different alkaloids are not separated from one another. This is prepared from the finely-powdered bark by mixing it with milk of lime and spirits of wine. At the close of 1882 there were in the Bengal plantations a stock of nearly five millions of trees, of which three-quarters were *C. succirubra*, yielding an annual crop of 400,000 lbs. of dry bark. The amount of capital altogether expended in Bengal in the plantations and manufactory was £100,000, and on this the receipts for 1878-9 yielded $4\frac{1}{4}$ per cent. on the capital outlay, exclusive of 5,500 lbs. of the alkaloid taken for the Government hospitals, which replaced an equal amount of quinine, which, if purchased, would have cost the Government £44,000. Dr. King estimates that by the end of 1878-9 the total amount saved to Government was £80,000, and Mr. Wood, the Government quinologist, estimates that the cost of the mixed febrifuge will ultimately be brought down to a shilling per ounce. The price of the sulphate of quinine in England has been reduced during the last few years from 13s. to 5s. per ounce. As before explained, only four out of the thirty-six species have been extensively planted in India, and of the economic value of many of the others very little is known clearly.

INDIA-RUBBER.—What is sold under the name of india-rubber is the stiffened milky juice of at least six different genera of trees, belonging to three widely different natural orders, *Landolphia* and *Willughbeia* in *Apocynaceæ*, *Castilloa* and *Ficus* in *Artocarpeæ*, and *Hevea* and *Manihot* in *Euphorbiaceæ*. Part of it comes from South America (shipped principally from Para and Carthagena), part of it from Sierra Leone, Mozambique and Madagascar, and the remainder from tropical Asia. Besides these two genera of *Apocynaceæ*, there are at least six others which yield a similar milky juice, which is not at present utilised to any considerable extent. In the United States in 1883 there were 120 india-rubber factories, employing 15,000 hands. The total importation of raw material into the States in that year was

30,000 tons, worth about six million pounds sterling. The value of the manufactured goods made in a single year is estimated at fifty million pounds sterling. The quantity of unworked rubber imported into the United Kingdom in 1883 was over 10,000 tons, worth about £3,500,000; but in 1885 it had sunk to less than £2,000,000.

None of the trees which yield india-rubber have yet been brought into cultivation on a large scale, and the time will soon come when either this will have to be done, or the supply will gradually lessen. There are about sixty distinct species in these rubber-yielding genera,* and the botanists

* *List of the india-rubber producing genera, their native countries, with the number of species in each, and annual import:—*

| Order. | Genus. | Number of Species. | Native Country. | Quantity Imported into England in 1880, in tons. |
|--------------|-----------------------------|--------------------|---------------------------------|--|
| Apocynaceæ | Willughbeia .. | 9 | Tropical Asia .. | 530 |
| Do. | Landolphia, including Vahea | 16 | Africa and Madagascar .. | 2,200 |
| Do. | Hancornia .. | 1 | Brazil .. | |
| Do. | Urceola .. | 7 | Malay Peninsula and Archipelago | |
| Do. | Dyera .. | 3 | Malay Peninsula | |
| Do. | Couma (Collophora) .. | 4 | Guiana and Brazil | |
| Do. | Alstonia .. | 3 | Malaya and Fiji | |
| Do. | Cameraria .. | 2 | West Indies .. | |
| Artocarpeæ | Castilloa .. | 3 | Central America and Cuba .. | 100 |
| Do. | †Ficus .. | 2 | Africa and Tropical Asia .. | 370 |
| Euphorbiaceæ | Hevea .. | 9 | Amazon Region | 3,768 |
| Do. | Manihot .. | 1 | Brazil .. | 35 |
| | | 60 | | 7,003 |

and foresters will have to settle between them which of these are best worth cultivating, and where it will pay to grow them. Unfortunately at the present time the price of india-rubber of all kinds is exceptionally low, the best Para rubber being now only worth about 2s. 6d. per lb. in London, against 4s. in 1884, and the best of the African and Asiatic kinds about 2s. per lb.

† There are altogether over 400 species of *Ficus*, but only two yield india-rubber.

GUTTA-PERCHA of the best quality is the product of *Dichopsis Gutta*, a tree belonging to the natural order Sapotaceæ, inhabiting the Malayan peninsula. In order to obtain it the Malays follow the wasteful and extravagant plan of cutting down the tree. The bark is first stripped off, and the milky juice which then exudes is collected in the shell of a cocoa-nut or the spathe of a palm. The juice quickly stiffens on exposure to the air, and forms gutta-percha. The average quantity obtained from one tree is 20lbs. In 1875 ten millions of pounds in weight were imported into this country from Singapore, and this would involve the destruction of 50,000 trees.

It was first brought into notice in 1842, and at that time the tree was plentiful in the forests of the island of Singapore, but during the next five or six years it was totally destroyed on the island, except a few trees that were kept as curiosities. In 1847 it was plentiful in the forests of Penang, but a similar fate soon befell it there, and now the time has come when, unless it be systematically cultivated somewhere, the supply will decrease. According to the latest authority, there are six distinct species of *Dichopsis* growing wild in the Malayan peninsula, and in Java and Sumatra, and several species of the neighbouring genera, *Chrysophyllum*, *Sideroxylon*, *Bassia*, *Mimusops*, *Payena*, and *Imbricaria*, yield a similar milky juice; but it still remains to be settled which species are best worth cultivating, and where they can be most profitably grown. The annual value of the gutta-percha imported into England is between £300,000 and £500,000 per annum.

TIMBER SUPPLY.

The burning question of forest destruction and our future timber supply it is impossible to deal with at all adequately in the time I have at command. Of the importance of the matter from a financial and economic point of view an idea may be formed from the admirable series of statistics got together by Professor Sargeant for the last census report of the United States. He estimates the annual value of the produce of the woods of the United States at 490 millions of dollars, or £100,000,000, the number of hands employed in the timber trade of the States at 148,000, their annual wages at 32,000,000 dols., and the number of persons in the States who are entirely dependent on wood as fuel at 32,000,000.

The following extract, which refers to the island of Jamaica, will give an idea of the reckless and extravagant way in which the natural forests have been destroyed in some of our colonies :—

“ In certain localities hundreds of thousands of acres have been converted into desert by the wholesale destruction of the forest. In other localities hundreds of thousands of acres would from the same cause now be utterly unproductive but for the planting of foreign trees, such as Logwood and Mango. In consequence of the facility with which land is everywhere available in Jamaica, the peasantry cut down annually 40,000 acres of forest land and thick bush, in which to plant yams and other provisions. Innumerable timber trees, young and old, are thus yearly destroyed. These clearances are made in the most seasonable districts, and in many instances the excessive rainfall in such districts is perceptibly diminished in consequence of the large extent of these clearances. No conservation of the forest having ever been attempted here, the result is, as regards timber, that the resources of the island are practically *nil*. There is indeed some timber in the inaccessible hills of the interior.

“ Nearly all the timber required for building purposes, the annual value of which amounts to about £50,000, is imported into the island. Even the sleepers lately used for laying down the few miles of tramway in and near Kingston were imported. The unproductiveness of the island in timber is to be further deplored when our luxuriant tropical resources are borne in mind, and also when it is remembered that only one-thirtieth of the island is devoted to agriculture. In the event of any considerable advancement in the prosperity of the island a very large expenditure would be entailed for the importation of timber.”—*Thomson, in Kew Report, 1877, p. 43.*

(*To be continued.*)

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, B.A., AND J. E. BAGNALL, A.L.S.

(*Continued from page 181.*)

Sub-genus VII.—MYCENA.

103. **Ag. purus**, *Pers.* *Ag. roseus*, *With.*, *Purt.* Woods and plantations. Sept.-Oct. Plantations, Edgbaston, *With.*, 253. Oversley Lane, *Purt.*, ii., 643. Oversley Wood; Ragley Wood, *Purt.*, iii., 224. Kenilworth, Sep., 1849, *Russell, Illustr.* Hopsford, near Brinklow, *Adams.* Marston Green; Trickley Coppice; New Park Middleton; in a copse at Kenilworth.

104. **Ag. pseudo-purus**, *Cooke*. Woods. Oct. Edgbaston Park; Bradnock's Hayes; Trickley Coppice and New Park, Middleton.

Probably a variety of the preceding.

105. **Ag. luteo-albus**, *Bolt*. Woods. Oct. The Spring, Kenilworth, *Russell, Illustr.*

106. **Ag. flavo-albus**, *Fr.* Amongst moss. Oct. The Common, Kenilworth, *Russell, Illustr.* Shilton, near Coventry, *Adams*. Upper Nut-Hurst, Sutton Park, *Dr. Cooke*.

107. **Ag. rugosus**, *Fr.* Roadsides. Rare. Aug. Marston Green; Packington Park.

108. **Ag. galericulatus**, *Scop.* *Ag. varius*, *With.*, *Purt.* On stumps and trunks of trees. Sept.-Nov. Edgbaston, *With.*, 237-8. Crackley Wood; Burton Green Wood; willow stumps, Birmingham Road, Kenilworth, *Russell, Illustr.* Warwick, *Perceval*. Combe, *Adams*. Longford, *Rugby Sch. Rep.* Sutton Park; New Park; Stechford; Olton; Marston Green; Shawberry Wood; Water Orton; Kinwalsey; Sharman's Cross, Solihull; Knowle; Corley, etc.

Var. *calopus*, *Fr.*, New Park, Middleton.

109. **Ag. polygrammus**, *Bull.* Stumps of trees. Oct. "The variety *polygrammus* was brought to me by my friend Mr. Rufford," *Purt.*, iii., 278; exact locality doubtful. Kenilworth, variety with smooth stem, *Russell, Illustr.* Combe, *Adams*. Wood near Wolvey; Coleshill Heath.

110. **Ag. pullatus**, *Berk.* and *Cooke*. On the ground amongst dead leaves. Sept.-Nov. Rare. *Cooke, Illustr.*, t. 257. New Park; pine wood, Coleshill Heath; Coleshill Pool; Water's Wood, Maxtoke.

111. **Ag. pauperculus**, *Berke.* Oak stumps. Rare. Oct. Oak stump, Kenilworth, *Russell, Illustr.*

112. **Ag. leptcephalus**, *Pers.* Very rare. Pine wood above Coleshill Pool.

113. **Ag. alcalinus**, *Fr.* On trunks of trees. Aug.-Nov. Warwick, *Perceval*. Kenilworth, *Russell, Illustr.* Binley, near Coventry, *Adams*. Sutton Park; Langley; Castle Bromwich; Water Orton; Shawberry Wood, Shustoke; Water's Wood, Maxtoke.

114. **Ag. ammoniacus**, *Fr.* On the ground amongst grass, overlooked. Marston Green; New Park, Middleton; Corley Woods. We fear this has often been overlooked through confusion with *Ag. alcalinus*. It grows singly, not cæspitose, and chiefly on grassy roadsides.

115. *Ag. metatus*, *Fr.* Amongst moss in woods. Oct. Amongst leaves and moss, New Park, Middleton, named by Mr. C. B. Plowright.
116. *Ag. stanneus*, *Fr.* Amongst grass, in woods. Rare. Oct. Coleshill Pool; Bradnock's Hayes.
117. *Ag. vitreus*, *Fr.* Woods. Rare. Sept. Water's Wood, Maxtoke? (1882).
118. *Ag. tenuis*, *Bolt.* Moist woods. Rare. Sept.-Oct. Burton Green Wood, Kenilworth, *Russell, Illustr.* Pine wood, Coleshill Heath, on sphagnum; Haywood, on sphagnum.
119. *Ag. filopes*, *Bull.* *Ag. varius*, var. 3, *With.* Amongst leaves in woods. Sept.-Oct. Edgbaston Park, *With.*, 237. Combe Woods, *Adams.* Sutton Park; New Park, Middleton.

Withering's plant can scarcely be this species.

120. *Ag. amictus*, *Fr.* Rare. Oct. Among fern roots, etc., under a glass shade, in the house, Birmingham; Cooke, *Illustr.*, t. 286.
121. *Ag. vitilis*, *Fr.* In woody places, among grass. Not common. Bradnock's Marsh; Olton Reservoir; Sutton Park.
122. *Ag. acicula*, *Schæff.* On sticks. Sept.-Oct. Hopsford, *Adams.* Driffold Lane, Sutton; New Park, Middleton.
123. *Ag. sanguinolentus*, *A. and S.* Amongst leaves in woods. Oct. Not uncommon. Sutton Park; Four Oaks; Trickley Coppice; Hams Hall; Marston Green.
124. *Ag. galopus*, *Pers.* Amongst leaves. Frequent. Sept.-Nov. Red Lane; Crackley Wood! Clarendon Villa, Kenilworth, *Russell, Illustr.* High Wood, Combe, *Adams.* Edgbaston Park; Sutton Park; New Park; Trickley Coppice; Coleshill Pool; Water Orton; Iron Stone Wood, Oldbury; Olton Reservoir; Solihull; Haywoods, etc.

Var. *candidus*, all pure white milk, abundant. See "Journal of Botany," xxii., 129. At Four Oaks.

125. *Ag. leucogalus*, *Cke.* Very rare. New Park, Middleton, on the ground, Oct. 7th, 1883. Cooke, *Illustr.*, t. 653, was not published at that time, but it represents the New Park species very closely; the description agrees exactly, except in the habitat. "I have just now (Sept., 1888) re-discovered this species at Langley; this time I observed it was attached to a fragment of wood in the soil."—W. B. G.

126. *Ag. epipterygius*, *Scop.* Amongst dead leaves. Oct. On the mossy bark of a tree, Kenilworth, *Russell, Illustr.* Combe Woods, *Adams.* Sutton Park; Trickle Coppice; New Park; Maxtoke; Brown's Wood, Solihull; Marston Green; Bradnock's Hayes.
127. *Ag. vulgaris*, *Pers.* Woods. Rare. Combe Woods, *Adams.* School Rough, Marston Green.
128. *Ag. tenerrimus*, *Berk.* Fir cones and twigs. Rare. Kenilworth, *Russell, List.* Greenhouse at Lady Adams', Ansty, *Adams.* Sutton, on dead bark; Four Oaks.
129. *Ag. electicus*, *Buckn.* Very rare. Oct. Sutton Park; Olton Reservoir; in both places on dead and rotting rush stems.
130. *Ag. corticola*, *Schum.* *Ag. corticalis*, *Purt.* On dead branches of bramble, &c. Rare. Oct. Ragley Wood; Oversley Wood, *Purt.*, iii., 214. Clarendon Villa, Kenilworth, *Russell, Illustr.* Hopsford, near Brinklow. *Adams.* Sutton; Olton Reservoir. *Merulius fætidus*, *Purt.*, ii., 620, from his garden at Alcester, is, *teste ipso*, a form of this; see iii., 391.

Sub-genus VIII.—OMPHALIA.

- [*Ag. pyxidatus*, *Bull.* Occurred among grass by the roadside, California, Harborne, Worcestershire.]
131. *Ag. sphagnicola*, *Berk.* On sphagnum. Rare. May-June. Bog above Blackroot Pool, Sutton Park, *Dr. Cooke*, 1883.
132. *Ag. hepaticus*, *Batsch.* Grassy places. Rare. Oct. Kenilworth, *Russell, Illustr.* By the railway above Blackroot Pool, *Dr. Cooke*, 1883.
133. *Ag. muralis*, *Sow.* Walls, &c. Rare. On a wall amongst moss, Edgbaston.
134. *Ag. umbelliferus*, *Linn.* Heaths. Sept.-Oct. Sutton Park; New Oscott.
- Var. *myochrous*, *Fr. Hym. Eur.*, p. 161. *Merulius fuscus*, *With.*, 147—"Packington Park, in clusters,"—is referred by Fries to this variety. The gills are described as subdichotomous, and the colour of the whole as fuscous umber.
135. *Ag. pseudo-androsaceus*, *Bull.* Heaths. Rare. On the top of an old wall at Wixford, Oct 15, 1820, *Purt.*, iii., 185. It is likely that Purton's plant was rather a form of the preceding species.

136. *Ag. stellatus*, *Fr.* *Merulius buccinalis*, *With.*, *Purt.* Amongst grass, on rotten wood. Rare. Feb.-Oct. Packington Park? *With.*, 146. Ragley Woods, *Purt.*, iii., 180. Olton Reservoir, Oct., 1881. This species is very doubtful, although the specimen from Olton certainly seemed to agree with the description.
137. *Ag. campanella*, *Batsch.* *Ag. fragilis*, *With?* Woods. Rare. Pool dam, Edgbaston? *With.*, 207. Withering quotes "Schæff, 230," which is this species, but the description of the stem does not agree, although that of the pileus and gills is fairly correct.
138. *Ag. fibula*, *Bull.* In mossy ground. Not uncommon. Sept.-Nov. Packington Park, amongst moss! *With.*, 173. Oversley Hill, *Purt.*, ii., 641. Edgbaston Park; Windley Pool; Sutton Park; Alveston Pastures. *Ag. parvus*, *With.*, 233, "pastures, Edgbaston, amongst short grass and moss," is doubtless the same species, although he quotes Bulliard's figure of *Ag. hiemalis*, *Osborne*, with which his description does not agree.
139. *Ag. integrellus*, *Pers.* On decaying sticks, in damp places. Rare. May-Dec. Maney, near Sutton Coldfield; School Rough, Marston Green.

Sub-genus IX.—PLEUROTUS.

140. *Ag. corticatus*, *Fr.* On decaying wood. Rare. Oct. Driffold Lane, Sutton.
141. *Ag. dryinus*, *Pers.* On trunks of trees. Rare. Oct. Ansty, *Adams*.
142. *Ag. ulmarius*, *Bull.* On elm trunks. Local. Sept.-Dec. On the branch of an elm, Kenilworth, *Russell, Illustr.* Driffold Lane, Sutton; Sutton Park; on a felled elm tree, near Solihull Railway Station.
143. *Ag. subpalmatus*, *Fr.* *Ag. palmatus*, *Purt.* On squared timber. Rather rare. Oct. On the trunk of a tree crossing the moat at Studley Castle, *Purt.*, ii., 656; Pophills, *Rufford*; at the bottom of a stump, Oversley, *Purt.*, iii., 430; Warwick, *Perceval*; Coventry Road, near Kenilworth, 1850; smooth variety, Kenilworth, *Russell, Illustr.*; Withybrook Lane, near Brinklow, *Adams*.
144. *Ag. craspedius*, *Fr.* On wood. Rare. Oct. A large cluster in a cellar, St. Vincent Street, Birmingham; *Saunders and Smith*, t. 7.

145. *Ag. fimbriatus*, Bolt. Rare. There can be little doubt that Withering's *Ag. infundibuliformis*, var. 2, "Bolt., 61," is truly this species; "in the Park at Packington," *With.*, 154. [Clusters of it have been found on old logs in a garden at Handsworth, Staffordshire.]
146. *Ag. ostreatus*, Jacq. On stumps and logs. Rather rare. Esculent. Nov.-Jan. Edgbaston Park, *With.*, 294; near Studley Castle; Oversley Mill, *Purt.*, ii., 655; Kenilworth, *Russell, List.*; Driffold Lane and Sutton Park; Legge Lane, Birmingham.
147. *Ag. enosmus*, Berk. On stumps. Rare. Sept. Elm, by Red Lane, Kenilworth, *Russell, Illustr.*
148. *Ag. salignus*, Fr. On trunks of trees. Rare. Oct. On a stump, near Warwick, *Perceval*.
149. *Ag. petaloides*, Bull., var. β , *Spathulatus*, Pers. *Ag. spathulatus*, *Purt.* On the ground. Rare. Oct. Oversley and other places in this neighbourhood, *Purt.*, ii., 656; cf. iii., 237, 431.
150. *Ag. acerosus*, Fr. Very rare. Dunspits Lane, Kenilworth, *Russell, Illustr.*
151. *Ag. applicatus*, Batsch. On rotten wood. Oct. Rosal Lane (Rose Hall Lane), Oversley, *Purt.*, ii., 659. Sutton Coldfield.
152. *Ag. chioneus*, Pers. On wood. Rare. Oct. Sutton Park, on fragments of bark.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Continued from page 148.)

PART V.—THE MIDDLE LIAS CONSIDERED AS A RECEPTACLE FOR WATER, WHEREBY FLOODS MAY BE MITIGATED.

The last few years, in this country, have been comparatively dry ones, and on this account chiefly, I presume, very little has been heard of floods, or river conservancy, or drainage schemes. It is only a few years, however, since excessive and destructive floods were of frequent occurrence in the Midland districts, and there was considerable discussion as to their cause, and as to how they might be prevented. The very fact that such destructive floods have not occurred along the Nen valley recently, points conclusively to the main cause of such floods, viz., *excessive and unseasonable rainfall*.

The injurious effects of floods are not confined to agricultural districts, but the low-lying parts of many towns, Northampton included, are subject to inundation, when, besides the actual damage and interference to traffic thereby brought about, some illness is generally the result. I have several times seen the flood water up to the axle-trees of carts in the lower streets of Northampton, a condition of things it is very desirable to avert if possible. No doubt many towns were formerly built in the situations where we now find them, because of the advantages afforded by water communication with other places, and although this is of less consequence now, on account of railways, it is impossible to alter the situation of a town. Valleys are often selected for railways, for the double reason, probably, that most towns are situated in or near them, and they offer less obstacles to engineers, and are therefore less expensive. Railways so situated are liable to damage from floods.

The damage done by floods in agricultural districts is often of a serious nature; animals are drowned, hay and other farm produce is spoiled or even washed away, and the herbage of the fields so injured by the deposition of earthy and confervoid matter on it as to be practically valueless. Besides the more evident damage done in this way, greater and more lasting injury is incurred from the sodden condition of the meadow lands, sometimes for a good portion of the year, during which time they cannot be used for stock, and a coarse and innutritious herbage is gradually replacing the better kinds of grass.

Summer floods are much more injurious than those occurring in winter. The temporary and permanent injury to grass is greater; there are then crops to be destroyed or injured, and an outbreak of "rot" in sheep is exceedingly likely to follow. It is now well known from the researches of Mr. A. P. Thomas, of Oxford, that the aquatic snails, *Limnæus pereger*, and *Limnæus truncatulus*, are capable of acting as hosts to the liver-fluke (*Fasciola Hepatica*) during one stage of its career; and as these snails are likely to be spread over the fields by summer floods, when the moisture and temperature are both favourable to the development of the eggs of the fluke, an outbreak of "rot" is exceedingly likely to occur.

Floods are not an unmitigated evil. Providing they come at the right time, and the water does not stagnate, they may be of great benefit. A form of irrigation which cannot be controlled must of necessity do damage at times, but I doubt very much whether occupiers of the meadow lands along the

Nen valley would care to be entirely relieved of floods ; they would prefer to have the water, if they could only have it at suitable times and get rid of it a little sooner, because of the fine silt which it brings, and which renders ordinary manuring unnecessary. Farmers are never likely to secure all these advantages, but some of them they might, providing they had somewhere to drain into ; this the water scheme under consideration provides.

There are many causes tending to produce floods, and the relative amount of importance attached to any one of them is somewhat a matter of individual opinion. I have placed below the commonly-assigned reasons for recent heavy floods in the Midland counties in the order of their importance, according to my own belief :—

- 1.—Excessive Rainfall.
- 2.—Agricultural Drainage.
- 3.—Blocking-up of Streams.
- 4.—Artificial Obstructions, such as Mills, Railway Banks, Bridges, &c.

1.—EXCESSIVE RAINFALL.—That the rainfall for a number of years previous to 1883 was excessive is, I take it, an incontrovertible fact. The wet period I refer to extended from 1872 to 1883, twelve years ; and from particulars furnished me by Mr. F. Law, for Northampton, I find that the average rainfall for the last nineteen years, including, of course, the wet period, is almost exactly 25 inches, whereas the average for the wet period was $27\frac{1}{4}$ inches, and the average of the dry period, that is three years previous to 1872 and four years since 1883, only 21 inches, showing a difference of $6\frac{1}{4}$ inches between the wet and dry years. The lowest yearly average is for 1870 (16·19 in.), and the highest is for 1872 (33·15 in.), a difference, it will be seen, of 16·96 inches. Three other years, 1875, 1880, 1882, gave averages nearly double of the minimum. It cannot be said that 33 inches is an excessive rainfall, except by comparison with drier years, and had the rain been more evenly distributed over the year very little damage would have resulted.

So far as my experience enables me to judge, I should say that it almost invariably happens that the excess of rain, above the average for the district, is due to heavy falls in a short period ; and these are particularly liable to cause floods, for much of the water will run over the surface of the ground even in well drained districts, and the floods very rapidly follow the rain. These heavy falls not unfrequently occur in the summer time, during thunderstorms.

An increased rainfall in a district need not be a cause of floods, for, if it is not particularly heavy, a rain may continue a long time before any very perceptible effect is noticed, depending upon the previous condition of the ground. After a dry period two or three inches of rain may fall before there is sensible percolation, much less floods; the huge cracks in even badly drained soils receiving and distributing a great quantity of water through the dry earth. At other times less than an inch of rain may produce considerable floods.

In July, 1875, very extensive floods occurred in the Midland counties; part of Northampton was under water, and the Nen valley was like one vast lake. The rains which caused these floods had been preceded by heavy rains a few days previously; and so the ground was well saturated, and made incapable of receiving much more water.* Other floods occurred later in the year, and altogether, perhaps, floods were more extensive and destructive than in any other year since 1852.

On Thursday, April 16th, 1885, about 1·15 inches of rain (partly snow at first) fell in Northampton from mid-night to mid-day, and this fall produced heavy floods in the Nen valley the same day, and lasting over the Sunday following. This had not been preceded by any exceptional rainfall.

In May, 1886, no rain fell for the first nine days. On the 10th there was ·10 inches, on the 11th ·45 inches, and on the 12th 1·07 inches, in all 1·62 inches in three days, and heavy floods were out in the Nen valley on the 12th. Hence we see how small an amount of rain may produce floods when the predisposing circumstances have not been exceptional.

Of course floods almost invariably follow the melting of snow, for although percolation is most easy at such times, owing to the disintegration of the ground by frost, it is generally more or less saturated with water, and the amount of snow melted may be the accumulation of several separate snow-storms. It is not unusual for the thaw to be accompanied by rain, which still further increases the flood. To these causes may be added one other: if the snow fell after frost had set in, when the thaw comes much water will run off the surface and accumulate in the valleys before the ground has thawed sufficiently to let any in.

According to the best information I can get, it appears that when a fall of rain occurs sufficient to cause a flood in

* For much valuable information on these periods of heavy rainfall see "On the Floods in England and Wales during 1875, and on Water Economy," by Geo. J. Symons. Paper read before the Institution of Civil Engineers, 1876.

the Nen valley, such flood will follow within 24 hours, and generally in less time than this. It is not uncommon for a flood to be at its highest in 12 hours. In winter $\frac{1}{2}$ inch of rain in 24 hours is sufficient to cause a flood, in summer time from 1 to $1\frac{1}{2}$ inches in the same time, depending upon the previous condition of the land. Floods in winter time will often last for weeks together in the Nen valley, and the ground most subject to these floods be unfit for stock for quite half the year. They are regarded as half-yearly lands.

2.—AGRICULTURAL DRAINAGE.—Although I have placed this second as an individual cause of floods, it must be regarded as quite subordinate to the one just considered, inasmuch as drainage is only intended to get rid of excess of water which, in most cases, has only a short time previously fallen as rain. I also wish it to be understood that I do not consider it equal to the aggregate of the other natural and artificial causes to be enumerated.

The advantages of land drainage in a country like England are so obvious that few words are required on this matter. It is very probable that, because of the considerable and evident benefits often derived from drainage, as with other good things, it has, in some cases, been imitative and indiscriminate, and therefore excessive.

There is no doubt it is much better for rain water to pass through the soil than simply over its surface, within certain limits as to quantity. In the latter case it will take much away, but not add anything itself, whereas in the former it will generally enrich rather than impoverish the land, so far as useful plant food is concerned. The rapid removal of water from the surface of ground is very desirable, both for the good of human beings and animals breathing the atmosphere above it, and for plants being grown in it. The temperature of well drained land is higher, and plant growth in consequence more rapid, and cultivation generally is a much easier and less precarious operation.

I know the opinion is held by some, that drainage has not been and cannot be carried to excess. It is asserted that undrained lands may suffer most in dry weather, for stagnant water in the early part of the year retards vegetation very much, and renders it more liable to damage from late frosts, both of which causes tend to produce a scanty herbage, or less luxuriant crop on arable land, and if the weather is hot and dry in May and June, they will both suffer more than if the crop had been more luxuriant and the ground better covered; that is, the productive capabilities of the soil are reduced to a minimum. If we accept this explanation, and

add to it the probability that there would be no lack of water during the summer, the case for extensive drainage seems very strong.

The average good from land drainage is vastly in excess of the evil, no doubt; but I cannot help sharing the belief that the scarcity of water in some water-bearing beds, and the calls for rain from farmers themselves, after an interval of dry weather, are partly due to extensive agricultural drainage, for whatever arrests percolating water reduces the springs from underlying porous beds, and whatever dries the soil reduces the interval between a shower and the time when another is required. I have several times traced drains in grass fields by the dry and withered condition of the herbage. I cannot think I should be far wrong in describing the drainage there as either indiscriminate, or excessive for that season, though perhaps only sufficient for others.

Taking Northamptonshire as a whole, I unreservedly accept the assurances of numerous farmers, several of them my personal friends, and all of them speaking with the authority of experience, that there is very little land over-drained in this county, but very much that requires draining.

(To be continued.)

Wayside Notes.

IN THE LAST NUMBER of the "Midland Naturalist" (p. 238), a specimen of *Cotula coronopifolia* was exhibited from Norway. It was then stated that it came from its only locality in Europe. This must be incorrect, since Nyman, in his *Conspectus*, gives it as occurring in Denmark, Germany, Holland, North Spain, and Portugal. Mr. C. Bailey has collected it in Cheshire, to which county (as probably to its European localities) it has been introduced. I saw it growing plentifully, and apparently native, in marshy ground between Cadiz and Algeciras, in 1887.

G. C. DRUCE.

RUSSULA CLAROFLAVA SP. NOV.—This species resembles *Russula ochroleuca*, and might by some be considered only a strongly-marked variety of that, but it differs in other points than colour so remarkably that it is, in my opinion, fairly entitled to be considered distinct. It has occurred for many years successively at Wyndley Pool, Sutton, and always presents the same appearance. In stature it approaches *R. citrina*, but resembles *R. ochroleuca* in the ultimately rugose and cinereous stem, which is at first white and smooth, but ultimately becomes even more darkly cinereous than in that species. The colour of the pileus is a pure rich chrome-yellow, even approaching the paler shades of egg-yellow, and the same tint is found occasionally on the base of the stem. The gills differ from both the species mentioned in becoming a pale lemon-yellow. The flesh, wherever wounded, becomes somewhat rufous. *R. claroflora*: pileus, 2-3 inch, convex, at first

bullate, then plane, slightly depressed in the centre, chrome-yellow; margin turned down, at length patent, perfectly even or slightly striate when old, often paler than the disc, but sometimes of a deeper colour; cuticle not so easily separable as in *ochroleuca*; flesh white, yellow beneath the cuticle; stem $1\frac{1}{2}$ - $2\frac{1}{2}$ in. \times $\frac{1}{2}$ - $\frac{3}{4}$ in., smooth, white, cylindrical, blunt at base, slightly spongy within, at length rugose and cinereous or even blackish; gills scarcely crowded, not reaching the stem so much as in *ochroleuca*, not united behind, white, then altogether pale-lemon yellow, at length sub-ochraceous. Amongst grass in damp places, Wyndley Pool, Sutton Coldfield. September-October.

W. B. GROVE, B.A.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—SOCIOLOGICAL SECTION, August 28th, Mr. W. B. Grove, B.A., in the chair.—Mr. Bagnall exhibited *Cuscuta Europæa*, *Bupleurum rotundifolium*, *Arundo Epigejos*, *A. Calamagrostis* from Upton, Warwickshire; for Mr. Bolton King, *Rosa scabriuscula*, from Gaydon; for Miss Gingell, *Helleborus viridis*, fasciated form of *Verbascum nigrum*, *Epipactis latifolia*, *Solidago virga-aurea*, &c., from Dursley, Gloucestershire; and a specimen of dry rot, *Merulius lachrymans*, from a manufactory in Birmingham. Mr. C. J. Wainwright exhibited larvæ of *Selenia illustraria*, a case of mimicry of sticks. Mr. W. B. Grove exhibited *Vicia tetrasperma*, *Sison anuum*, and *Hypericum hirsutum*, from Spernal, and a number of Fungi, among which were *Cortinarius torvus*, *Ag. infundibuliformis* var. *membranaceus*, and *Nyctalis parasitica*, growing on old stems of *Russula nigricans*, and itself having *Hypomyces baryanus* parasitic upon its gills. Mr. J. Edmonds exhibited *Bovista nigrescens* and *Lycoperdon gemmatum* var. *furfuraceum*, from Pendinas Wood, Aberystwith. MICROSCOPICAL SECTION.—Meeting, Tuesday, September 4th, Mr. J. F. Greenway in the chair. Mr. Buncher was duly elected a member of the Society. Mr. T. E. Bolton exhibited *Chirocephalus diaphanus*, the fairy shrimp. Mr. W. P. Marshall, M.I.C.E., exhibited some interesting plants that he had collected with Mr. Pumphrey in Norway. BIOLOGICAL SECTION.—Meeting, September 11th, Mr. W. B. Grove, B.A., in the chair. The following exhibits were made:—By Mr. Herbert Stone, a very interesting series of plants from Budleigh Salterton, including *Erodium moschatum*, *Iris fœtidissima*, *Lycopodium Selago*, *Ruscus aculeatus*, &c. By Mr. E. W. Wagstaffe, *Peziza scutellata*; also coal from Hamstead Colliery, enclosing spores of *Salvinia*. By Mr. W. B. Grove, fungi, *Leotia lubrica* and *Russula claroflava*, from Sutton Park. By Mr. J. E. Bagnall, A.L.S., for Mrs. E. Hopkins, *Arctostaphylos Uva-ursi*, *Sphagnum acutifolium*, *S. fimbriatum* in fruit, and *Dicranella cerviculata*, from Foxfield, Westmoreland; for Miss Gingell, *Clematis Vitalba*, *Picris echioides*, and an edible fungus, *Cantharellus cibarius*, from Dursley, Gloucestershire; for Mr. W. R. Hughes, F.L.S., *Festuca rigida* and *Catalpa syriacæfolia*, a fine tree, native of North America, from a plantation near Rochester; for Mrs. Coker Beck, the rare *Gentiana germanica*, and a fungus, *Spathularia flavida*, from Crowell, Oxfordshire. GEOLOGICAL SECTION.—September 17th, Mr. T. H. Waller, B.A., B.Sc., in the chair. Mr. Wilkinson exhibited: *Selenite* crystals, and a collection of fossils, including

Ammonites, from the Oxford clay at Weymouth; a rare swimming crab, *Polybius Henslowii*; a collection of butterflies from the neighbourhood of Weymouth, including the Marbled-white *Hipparchia Galathea*, the Grayling *Hipparchia Semele*, Chalk Hill Blue, *Polyommatus Corydon*, and Lulworth Skipper, *Hesperia Actæou*. Mr. W. B. Grove: *Agaricus serrulatus*, *A. asprellus*, *A. carneus*, *Bolbitius hydrophilus*, and *Lactarius chrysorrheus*, from Corley; and *Ag. hæmactus*, from Ansty, for Rev. D. C. O. Adams. Mr. Bagnall: *Vicia tetrasperma*, *Sparganium neglectum*, *Epilobium tetragonum*, and fungi, *Hydnum repandum*, *Cortinarius elatior*, and other fungi from Wappenbury. Mr. W. Pumphrey, as a delegate of this society, gave a report of the Meeting of the British Association at Bath. Mr. Hughes drew the attention of the Council to the death of Mr. Philip Hy. Gosse, and he and several members of the Council expressed their deep sense of the loss science had sustained by the death of such a man. Mr. Bagnall exhibited, for Mr. T. Hooper, *Drosera rotundifolia* and *Myosotis cœspitosus*, from Cannock Chase. Mr. Marshall exhibited and described the cylinders of the graphophone, by Tainter.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—August 20th. Mr. W. DUNN exhibited rock specimens from the Arctic Regions, said to contain gold and silver; Mr. Corbett, specimens of *Avicula contorta* and *Astræa liassica* from the Rhætic beds, Knowle; also quartz containing gold from Merionethshire; Mr. W. Dunn then read a paper on "Planarian Worms." The commonest forms of these objects are found in almost every pond gathering, and may be seen gliding over the surface of the glass. These worms bear characters that readily distinguish them from leeches, for which they are often mistaken. They have no suckers or feet, the body being covered with cilia, by which they are able to move. Their mode of life is never parasitic. Their cellular and muscular structure, digestive organs, methods of feeding, nervous system, eye spots, and respiratory organs were spoken of, and the development from the eggs and multiplication by budding and fission described. The writer said really very little was known of these creatures, and students of pond life might profitably devote some time to the subject. A discussion on the paper closed the meeting. —August 27th. Mr. J. Madison exhibited a case of *Limnæa peregra*, showing its named varieties and their variability, and gave a short account of their habitats and geographical distribution; Mr. P. T. Deakin, a case of *Bulimus*, Pupa, *Clausilia*, and other shells, calling attention to the clausilium of the *Clausilia* and the operculum of *Cyclostoma*; Mr. J. Moore, a number of *Helices*, &c., and their odontophores; Mr. Camm, the following fungi, *Diachæa elegans* and *Tremella sarcoides* from Hamstead, and *Ascobolus furfuraceus* from Harborne; Mr. A. T. Evans, specimens of stick-lac on twigs of trees from India. Under the microscope, Mr. H. Hawkes showed *Stemonitis ferruginea* from Hamstead. —September 3rd. Mr. P. T. Deakin showed a collection of ferns from Hong Kong; the Curator, section of *Atropa belladonna*. —September 10th. Mr. P. T. Deakin presented to the library a collection of mounted microscopic fungi, with observations. Mr. W. Harcourt Bath exhibited a specimen of *Astrorhiza lovoni* from Aberdeen, a starfish rarely taken in British waters, also a specimen of *Echinocardium pinnatifidum*, and one of an allied species as yet unnamed, both from the Scilly Isles. Under the microscope, Mr. J. W. Neville showed the fructification of a fern, and the same object

in a fossil state in a section of coal-ball material. Mr. H. Hawkes, slides of *Tilmadoche nutans* and *Thelephora laciniata*. Mr. W. B. Grove made a few remarks on the Myxomycetes, describing the difference between an ordinary fungus and a myxomycete. The former when germinating produced mycelia, the latter amœboid forms; these, called myxamœbæ, coalesced, and though the individual amœbæ could not be made out, yet the whole mass of the plasmodium slowly crawled. When it had taken sufficient food it began to assume its mature form, and then hardened to a horny consistence, and the internal protoplasm separated into spores. This completed its life history.—September 17th. Mr. P. T. Deakin exhibited a specimen of *Planorbis carinatus* var. *alba* from the Stratford Canal. Mr. H. Hawkes the following fungi, *Agaricus phalloides*, *A. mollis*, and *Lactarius rufus*. Mr. W. H. Bath, a Dragon Fly, *Gomphus*.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.
—SECTION D, ZOOLOGY AND BOTANY.—Chairman, F. T. Mott, F.R.G.S. Evening Meeting, Wednesday, September 19; attendance, fourteen (two ladies). The Secretary reported that the field-day on the 12th was attended by eight members, who went over the fields to Great Stretton, a small village on the old Roman *Via Devana*, returning by road.—Exhibition of Seedvessels: Miss Grundy, Miss Noble, and Mr. Knowles contributed examples of seedvessels of the Umbelliferae, Cruciferae, Labiatae, Sapindaceae, Cupuliferae, and other orders; but the finest collection was exhibited by the Rev. T. A. Preston, who had collected and arranged in three trays about one hundred fresh seedvessels, all of which were carefully named. He had also fine examples of the Brazil nut pod and the huge monkey-pot, containing the Sapucaya nuts. Mr. Headley exhibited a fine specimen of the Oak Beauty moth (*Amphydasis prodromaria*), which he captured last March, near the Victoria Park, and which had not been previously recorded in the county. The Chairman stated that he had measured the growth of a plant of *Antirrhinum majus*, from August 13th, when it was 11½ in. high, to September 19th, when it was 26 in., and found that its rate of growth, which was at first ⅙ in. per day, gradually increased to ½ in., the most rapid growth being that of the flower spike after emerging from the upper leaves. A paper on "The Parasitic Phanerogams of Leicestershire" was read by Mr. Thomas Carter, LL.B., including the genera *Lathraea*, *Orobanche*, *Cuscuta*, and *Viscum* as undoubted parasites, and those of *Rhinanthus*, *Bartsia*, *Euphrasia*, *Pedicularis*, and *Melampyrum* as somewhat doubtful. The author referred to the theory that some of these parasites, having no chlorophyll, were compelled to seek their carbon from the juices of other plants, or, as it is sometimes stated, having learnt to live upon the labour of others they gradually ceased to produce chlorophyll, but pointed out that there were difficulties in the theory in either form. The Mistletoe has abundant chlorophyll even in the roots which penetrate the branches of its host, and the Orobanches often grow to a much larger size than the little plant upon whose slender root they have seized, and which yet does not seem much the worse for their embrace. A lively discussion followed, during which the Rev. T. A. Preston stated that he had once taken the trouble to trace the root of an *Orobanche* which gradually diminished to a very slender thread, and at the distance of six feet horizontally he found it attached to a rootlet of *Centaurea scabiosa*. The *Orobanche* had other roots which descended into the soil.

THE LIFE-HISTORY OF A MYXOMYCETE.*

BY T. P. BLUNT, M.A., OXON.

A tree had fallen down the steep bank on the further side of the river, and its broad exposed roots formed a warm and shady nook with the soil from which they had been torn; the cavity was partly filled with fallen leaves, and scattered over these were some white spots, as large as half-a-crown, of semi-fluid substance. The source of them was found to be a mass of similar substance, eight to ten inches across, partly hidden among the roots of the tree. This mass resembled clotted cream more than anything else, both in appearance and consistence, but it was of dazzling whiteness. The layer may have been from a quarter to half an inch thick, and it had overflowed in the manner described on to the leaves below. It had a strong fungus-like smell. A little of the substance was taken home, and examined under the microscope; it was finely granular, and streaming movements were observed in it, which at the time were thought to be accidental, but have since been ascertained to be characteristic of it.

The spot was visited at intervals, when the following changes were observed:—First, a delicate and beautiful purple tinge began to show itself on the surface both of the original layer and of the drops upon the leaves. This deepened in tone gradually, until it became a deep full black, and then it was noticed that the mass was no longer formless, but now consisted of a collection of bodies not so large as peas, closely resembling tiny puff-balls, and full of a black powder. I had been watching several stages in the life history of *Brefeldia maxima*, a large species of that division of the fungi called Myxomycetes. I say division “of the fungi” with some little hesitation, for their biological position is still held to be doubtful by some eminent mycologists, and the source of doubt lies in that part of their history to which we have now come. The powdery matter in the round receptacles consists of spores. Let us see how these germinate; if some of them be placed in water on a microscopic slide and kept warm, they will be seen after a short time to swell, and then to burst, upon which a minute piece of white jelly creeps out from the integument. Under a high power this appears to be of a roughly triangular form, and to be furnished with a

* Read before the Caradoc Field Club, September 28th, 1888.

flagellum or "tail," which it uses for purposes of locomotion. Its movements consist partly of jumps through the water, effected by the aid of the flagellum, and partly of a creeping motion over the surface of the glass; under the latter circumstances, it exactly resembles an amœba in appearance, and, like the amœba, it is able to thrust out portions of its substance into the finger-like projections, called pseudopodia. It shews some curious antipathies and predilections; it will creep away from strong light, and towards moderate warmth. After a time, under favourable circumstances, each body begins to divide itself into two, and the numbers of amœba-like organisms thus increase rapidly by the process of fission.

The next stage consists in the coalescence of the isolated bodies into larger masses, and here the microscopist will be reminded of a phenomenon frequently observed in the case of another of the protozoa, not far removed from amœba, viz., *Actinophrys*; two, three, or more of these will often approach each other, and gradually coalesce into what appears to be a single large organism. This phenomenon is not of the nature of conjugation, but it is a mere amalgamation, usually resolved after a time.

The union of considerable numbers of the amœbiform bodies into larger masses, and the subsequent coalescence of the latter, result in the snowy cream-like substance from which we started, as found, in the case of *Brefeldia*, upon the roots of trees, and it may be well now to trace a little more minutely the subsequent stages of its growth.

It is endued, like the units of which it was originally composed, with motile power. It is capable of creeping over surfaces in order to avoid unfavourable conditions or to seek advantageous ones, and this movement can sometimes be followed by the unaided eye.

The mass also increases rapidly in size by the absorption of nutriment from the substratum, and is capable, as we have seen, of overflowing its borders and dropping on to neighbouring surfaces.

It seems probable that the plasmodia—as the masses are called which are formed by the coalescence of the zoospores—have another property which brings them very near to the protozoa, that, namely, of supporting themselves in some measure by the absorption of solid food; they certainly approach, embrace with their pseudopodia, and ultimately engulf small particles of solid nutrient material, which they eject at a later stage.

As has been already stated the surface of the plasmodium in *Brefeldia* gradually acquires a purple and ultimately a black

colour. Concomitantly with this change of tint differentiation occurs in the substance, the surface becomes warty, the membranes which will ultimately become the "peridia" or walls of the receptacles are secreted, and within them is enclosed the spore plasm. This divides, for the most part, into a number of minute fragments which become coated with cellulose and form the spores; some portion of it, however, is converted into the "capillitium," a delicate network of threads running amongst the spores, the function of which is not in all cases quite clear. Nearly the whole of the plasmodium is, in the case of *Brefeldia*, used up in the formation of the receptacles, or "sporangia" as they are called, and their contents.

The spores, in the case of *Brefeldia*, seem to escape simply through the decay and breaking down of the receptacle, but in some species of Myxomycetes the capillitium assists, by its elasticity, in the rupture of the sporangium and the dispersion of the spores.

The curious mixture of animal and vegetable attributes observed in the Myxomycetes, has led some naturalists to give them the name of Mycetozoa, or "fungus-animals," a thoroughly appropriate term, for, as we have seen, the organism whose history we have been considering, exhibits during two-thirds of its life the characteristics of an amœba, which is unhesitatingly classed among the animals; while in the remaining third it so closely resembles the common puff-ball, as actually to have received the synonym of *Lycoperdon Epidendron*—"tree-puff-ball." We have here one more proof, if more were needed, of the impossibility of laying down inflexible lines in the classification of natural objects. Classes and divisions melt insensibly into each other, and have in fact no real existence except as mental conceptions, useful for the orderly apprehension of natural phenomena, but limited in their application. To a want of recognition of this limit may be traced many fruitless and constantly recurring discussions.

I should like to ask your attention for a few minutes to a speculation as to the cause of the remarkable colours assumed by the Myxomycetes; these are principally bright yellow, reddish yellow, and black, the latter reached in *Brefeldia*, through deepening shades of purple. There is no doubt that light is inimical to the delicate protoplasm of which the plasmodium is formed, and it has long been known that some species exercise their motile power in order to avoid it. Professor Allman in his address to the British Association, nine or ten years ago, drew attention to this property in *Fuligo*, or as it was then called *Æthodium*, the "flowers of

tan." We have seen that our *Brefeldia* selected the shadiest situation attainable for its habitat, and it is certain from the investigations of numerous enquirers, my own among the number, that colourless protoplasm cannot encounter strong and continuous light, without serious injury, if not death.

In a paper which I read in this place last year, I drew attention to the protection against the injurious action of light afforded to the colourless protoplasm of the plant by chlorophyll, or the green colouring matter of leaves and other organs; and the intense colouring of the *Myxomycetes*, I am convinced has a similar function. Its history, however, is very different from that of chlorophyll. It is in no way dependent on light for its production, but is, as I have proved by direct experiment, formed in normal quantity in complete darkness. The true explanation of its appearance is, I believe, to be found in adaptive variation, in its most simple and typical form. Individuals which had acquired a slight tint through causes perhaps quite independent of light, were able to exist in situations more favourable to their growth in other respects, but impracticable for their unprotected companions, owing to strong illumination. Thus a distinct advantage was conferred upon the coloured specimens, resulting in greater robustness and permanence, and so in the course of successive generations just those colours came to be developed which afforded most protection against the injurious influence of light.

INSULARITY.

BY THE REV. H. H. SLATER.

(Concluded from page 246.)

Let me assure you that this picture of purposeless slaughter and suffering is not in the least degree overdrawn, but only such as I have myself witnessed over and over again, and such as may be seen in suitable localities on our coasts every autumn. And the actors are apt to use the word "sport," and to say that they have enjoyed "good sport" and so on. Sport, forsooth! If this were the general meaning of the word "sport," field sports would deserve to be doomed tomorrow, and would die unregretted by all who had any of the feelings of a gentleman or a Christian. Happily the humanity of real sportsmen is not a thing which requires to be demonstrated.

To return to the collector. He is a person, as a rule, who takes no sort of interest in the structure or habits of the

creatures he amasses the mummies of—a creature is of no value to him until it has been killed and filled with wires and cotton wool, or put in a drawer with a pin stuck through it. His ambition is to have as complete a collection as possible of the birds, insects, or plants of his vicinity. How far the appearance of those objects is connected with the nature of the soil, or the seasons, and what functions they discharge, are matters that do not enter into his ken; enough for him that he has examples of them in his collection. On the whole, it is much to be regretted that persons afflicted with the “*cacoëthes possidendi*” do not more generally turn their attention to second-hand postage stamps.

Not but what they do at times benefit science by turning up an unexpected species; but, as a rule, they miss the great rarities for want of accurate knowledge. Not but what, too, the possession of specimens not unfrequently generates a wish to know more of them, which leads to better things. But I should consider that the good they do is quite counterbalanced by the evil; for it is impossible for some of the more conspicuous birds, such as the golden oriole, the hoopoe, and the larger birds of prey, to get a footing in our country, owing to the ceaseless vigilance of the collector; and some birds are verging on extinction, as British residents, owing to their senseless persecution by game-preservers, and the high prices that collectors will give for their eggs.

I would implore all who are anxious to obtain the eggs of the rarer British birds, to be content with foreign specimens, from countries where they are abundant enough not to be missed. I have not the least doubt that I have found thirty nests of the woodcock in Britain, but I have only one egg, and that was an addled one. And I have taken one egg of the crane, and that was addled also.

Foreign eggs and skins are quite as valuable for purposes of study and comparison as those taken at home, and we naturalists ought to set our faces against insularity in the shape of the unjustifiable and injurious rage for British-killed skins, and British-laid eggs of those birds which are within a measurable distance of extinction in our islands. I will just add here a little story, which is not, I think, an unfair skit upon the mere collector. It was of a Yorkshire collier, who had just lost his only child, and who was being condoled with by a friend. He said, tearfully, but with earnestness, “Ah dew wish ah’d had t’lyle beggar stuffed.”

I cannot help looking upon the Wild Birds’ Protection Act as a specimen of insularity. In so doing I would not be thought to question the propriety of its main object—far from

it. The brutalities of the sea-side gunner are notorious and abominable, and every one is heartily anxious to secure the sea-fowl from his cruelty, and, for the matter of that, to secure the land-birds from an almost equally pitiless trio—the village loafer, the game-preservee or game-keeper, who looks upon nature as a vast establishment, in which he is a main actor, for raising the greatest possible number of young pheasants and partridges; and, thirdly, the farmer who is prejudiced and indiscriminating enough to see in the presence of any kind of bird whatever the attack of a direct foe. But the Act itself bears evidence of having been the work of those who had very little practical knowledge of their subject, with the assistance of a few third-rate naturalists and sentimentalists. The schedules containing the names of the birds are simply ridiculous. And the consideration of the Act leads me to notice its practical injustice. In no other country of which I have any experience is the scientific worker treated by the legislature with such contemptuous indifference as in this. Our Government does very little indeed, comparatively, for the science which enriches and ennobles the country—does not even go the length of securing facilities. The English ornithologist, who is suddenly brought face to face with, perhaps, a unique opportunity for adding a new record (as the cant word of the day has it) to the Fauna of his country—if it be during the close season, and he a person of any sensitiveness—must naturally hesitate to incur the familiar indignities of the English law. He is well aware of the “Old Bushman’s” dictum, which has passed into a common proverb with ornithologists, that “what is hit, is history; what is missed, is mystery.” But he also knows, that if he gave the rein to his scientific enthusiasm, and had the ill-fortune to be brought in consequence before the Bench to answer for his enormities, the magistrates, however much they might sympathise with him, would be powerless, and would have to lay on him a penalty, and a stigma, which the right hon. member for Derby, in his well-known tender gentleness, has put it out of their power to lay upon the back of the prowling loafer, who, for mere greed, shoots a doe hare with helpless young ones dependent upon her.

I cannot see why a recognised worker in natural history should be unable to obtain the privilege of a license to procure during the whole year the few birds he is likely to want, on the understanding that his doing so was, according to his judgment, for the benefit of science, and that he satisfied the requirements of the Inland Revenue Board in the matter of a game license. Such a document, countersigned by the

presidents of the British Ornithologists' Union, and of the Zoological Society of London, would surely be a sufficient safeguard against abuses. I have had such a privilege gracefully accorded to me in other countries—notably in a French colony, in the close season.

With this growl I will bring my remarks to a conclusion, hoping I have not wearied you beyond endurance. I will end with expressing my infinite regret that I have been obliged to figure before you at all, instead of listening to our much lamented President, the Lord Lilford, who cannot be present on account of ill-health; who, being a Past Master in the science of ornithology, would no doubt have given us an address really worth listening to.

ON KEW GARDENS AND SOME OF THE BOTANICAL STATISTICS OF THE BRITISH POSSESSIONS.

BY J. G. BAKER, F.R.S., F.L.S.

(Concluded from page 255.)

Or take the history of *Sequoia gigantea* (commonly known in English gardens as *Wellingtonia gigantea*), the prince of all the Coniferous trees, as told in a recent paper by Sir J. D. Hooker (*Gard. Chron.*, N. S., vol. x., pp. 216, 217):—

“The *S. gigantea*, or bay-tree (the *Wellingtonia* of British gardens), again, is a plant of a cooler climate [than that of the Californian lowlands], and hence having survived the glacial cold was enabled to establish itself in the Sierra Nevada, under certain very restricted conditions. It extends at intervals along the western slope of the Sierra to a little north and south of the parallels of 36° and 38° N., that is for nearly 200 miles in a north-west and south-east direction, at an elevation of 5,000 to 8,000 feet above the sea. Towards the north the trees occur as very small isolated groves of a few hundreds each, most of them old, and interspersed amongst gigantic pines, spruces, and firs, which appear as if encroaching upon them. Such are the groves visited by tourists (Calaveras, Mariposa, &c.). To the south, on the contrary, the Big Trees form a colossal forest, forty miles long and three to ten miles broad, whose continuity is broken only by the deep sheer-walled canons, that intersect the mountains. Here they displace all other trees, and rear to the sky their massive crowns; whilst seen from a distance, the forest presents the appearance of green waves of vegetation, gracefully following the complicated topography of the ridges and river basins which it clothes.

“The millennia during which these *Sequoia* trees must have remained *in statu quo*, proving the long duration of existing conditions of climate, are but as minutes compared with the time occupied by the migration of this very species or its ancestors north and south in the continent of America. Whatever might otherwise be the extent of the *Sequoia*'s travels, they are now at an end. Man has pronounced the sentence, ‘Thus far shalt thou go, and no further.’ The doom of these noble groves is sealed. No less than five saw-mills have recently been established in the most luxuriant of them, and one of these mills alone cut, in 1875, two million feet of big-tree lumber; and a company has lately been formed to cut another grove.

“In the operations of the Californian wood-cutters the waste is prodigious. The young manageable trees are first felled; after which the forest is fired to clear the ground and get others out, and thus the saplings are destroyed. More destructive yet are the operations of the sheep-farmers, who fire the herbage to improve the grazing, and whose flocks of tens of thousands of sheep devour every green thing, and more effectually than the locust. The devastation of the Californian forests is proceeding at a rate which is utterly incredible except to an eye-witness.”

The value of the wood annually wasted through fires at the present time in the United States is estimated by Professor Sargeant at twenty-five million dollars.

INDIAN FORESTS.

In India fortunately the state of things is very different. For a long time a large area of forest has been under Government protection, and there is a regular forest department fully organised as a branch of the Civil Service. The results have been most satisfactory, for not only have the forests been kept up for the benefit of succeeding generations, and new trees planted when old ones have been cut down, but the department yields a handsome profit annually. Twenty years ago its annual receipts were 36 lakhs of rupees, and the charges were 22 lakhs, leaving a balance on the right side of £140,000 a year. In 1882-3 the receipts were 95 lakhs of rupees, and the expenses 60 lakhs, leaving a balance of £350,000 on the right side. Dr. Brandis, who for nineteen years has been the director of the department, has lately retired. The total area of protected forest is now 35,242 square miles (about two-thirds of the area of England).

To individualise the different timber trees is of course one of the principal tasks with which the officers have to deal.

Dr. Brandis worked at Kew for a couple of years in the preparation of a hand-book of the timber trees of the North-west provinces; and one has been written for the Madras Presidency by Colonel Beddome, and one for Burmah by Dr. Kurz. A most valuable general handbook of all the Indian timbers has lately been published by Mr. J. S. Gamble, in which 906 species belonging to 432 genera are included. In the American forest there are over 400 different species; in Britain only about forty.

SUMMARY.

To sum up, then, I would say that, to understand properly what is to be seen at Kew, a visitor must bear in mind that four separate and more or less distinct objects are aimed at, and that the different departments fit into one another closely and work together hand in hand along four more or less distinct grooves. Firstly, the Gardens are a holiday resort for a large mass of the general non-scientific public. Secondly, they aim at helping horticulture by exhibiting in a living state a series of the principal types of structure, and by furnishing a means of identifying the plants that come into the country. Thirdly, they aim at promoting systematic botany by furnishing a means of identifying the plants, more especially of the British possessions abroad, or of those collected by British expeditions or private travellers in other parts of the world. And fourthly, the establishment has its economic sphere of usefulness, on which I have already fully expatiated. About the Laboratory and the Picture Gallery I have said nothing, but the uses of these need no explanation. I think the main drawback which all the officers of the establishment more or less feel is that amidst this crowd of aims and the vast mass of details, it is impossible for them to concentrate their attention upon any one thing for any considerable length of time.*

* Since this valuable paper was read the authorities of the Royal Gardens, Kew, have issued a monthly serial, in which is given information similar in nature to that given above. This serial is entitled a "Bulletin of Miscellaneous Information." The first number was published in January, 1887, and was prefaced with the following:—

"NOTICE.—It is proposed to issue from time to time, as an occasional publication, notes too detailed for the Annual Report on Economic Products and Plants, to which the attention of the Staff of the Royal Gardens has been drawn in the course of ordinary correspondence, or which has been made the subject of particular study at Kew. It is hoped that while these notes will serve the purpose of an expeditious mode of communication to the numerous correspondents of Kew in distant parts of the Empire, they may also be of service to

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 224.)

“The New Botanists’ Guide,” by Hewett Cottrell Watson, was published in 1835. The list of plants for the county of Worcester is founded almost entirely on materials supplied by the late Mr. Edwin Lees. In addition to the list contained in the “Illustrations of the Natural History of Worcestershire,” Mr. Lees furnished Mr. Watson with a checked catalogue of plants in Worcestershire or on its borders. The latter, distinguished by Mr. Watson by the words “Lees’ cat.,” include the following records, the localities in many instances being unhappily omitted:—

Papaver hybridum. See “*Botany of Worcestershire*,” p. 39.

P. hybridum is in Pitt’s List, 1810, see “*Midland Naturalist*,” Vol. X., p. 201, where, however, I affixed to it a sign of discredit.

Hesperis matronalis. Occurring sometimes, but obviously a garden outcast.

† **Sisymbrium Irio.** *Must, I think, be an error.*

† **Isatis tinctoria.** On a marl cliff close to the Severn, Mithe Toot Hill, Tewkesbury, where the Severn divides Worcestershire and Gloucestershire. *This locality is in the county of Gloucester.*

Reseda lutea.

† **Stellaria nemorum.** *Must be an error.*

Geranium pyrenaicum.

† **Genista pilosa.** *An error. Said to have been gathered at Little Malvern by the late Mr. Borrer. See Lees “Botany of Worcestershire,” p. 73.*

Rubus suberectus.

R. rhamnifolius.

R. Kœhleri.

members of the general public interested in planting or agricultural business in India and the Colonies.

“W. THISTLETON DYER, *Director.*”

“1st of January, 1887.”

This work has appeared regularly, and has been well sustained. The information supplied has been both valuable and of interest to all who take an interest in the prosperity of our colonies, and gives one a better idea of the good work which is being done at Kew than could be obtained from any other source. The bulletin is issued to the public at twopence per number, and is printed by Eyre and Spottiswoode.

J. E. B.

Potentilla verna. Rocks and summit of the Malvern Hills.
Recorded by Southall, 1825, and in "Midland Medical and Surgical Reporter," 1828. If the above belong to Hereford, this will be the first Worcester record.

Rosa sepium.

R. systyla.

Myriophyllum verticillatum.

† *Cicuta virosa.* *An error.*

Sison Amomum.

Torilis infesta.

Coriandrum sativum.

Fedia dentata.

Lactuca virosa.

† *Vaccinium Vitis-Idæa.* Lower Bromsgrove Lickey. *Must, I think, be an error.*

Pulmonaria officinalis. By the side of a wood at Lower Sapey, apparently wild, in 1834.

† *Asperugo procumbens.* *Must be an error.*

Myosotis collina.

M. sylvatica.

Mentha gentilis.

† *Calamintha Nepeta.* *Must be an error.*

† *Salvia pratensis.* *An error.*

Centunculus minimus.

Chenopodium hybridum.

C. urbicum.

C. polyspermum.

Rumex pulcher.

Quercus sessiliflora.

Carpinus Betulus. Not common.

Populus canescens.

Salix Russelliana, var. of *S. fragilis*.

S. vitellina, var. of *S. alba*.

S. amygdalina, var. of *S. triandra*.

S. cinerea and var. *aquatica*.

Narcissus poeticus. Found in a dubious spot. (*Not a native.*)

† *Allium arenarium.* Battenhall, near Worcester. On red marl.

This must be intended for the Allium arenarium of Smith's "English Flora," Vol. II., p. 134; a form of Allium Scorodoprasum, L. I suspect an error. The species is not certainly known in England south of the county of York.

Lemna polyrrhiza.

Luzula Fosteri. Cotheridge. Rev. A. Bloxam.

Eriophorum vaginatum.

† **E. gracile.** *An error.*

Carex divulsa.

† **Ammophila arundinacea.** *Must be an error.*

Bromus erectus.

* **Lolium temulentum.** The var. *arvense* of this species is noticed by Purton.

Senecio squalidus. Walls near the Cathedral, and adjoining the river at Worcester. Is inserted in the list on the authority of the Rev. A. Bloxam.

About the time with which we are now dealing, William Addison, F.L.S., surgeon to H.R.H. the Duchess of Kent, was in practice at Malvern. Mr. Lees, in the first edition of his "Botany of the Malvern Hills," 1843, acknowledges his obligations to him. In the second edition of the same work, 1852, he mentions that his friend Dr. Addison, F.R.S., has now left Malvern. The fourth volume of "The Transactions of the Provincial Medical and Surgical Association," London and Worcester, 1836, contains, p. 82, an article by Mr. Addison "On the Medical Topography, Statistics, &c., of Malvern, and of the District at the base of the Malvern Hills." At pages 141 to 146, under the head of Appendix No. 1, is "a List of the Rarer Plants indigenous in the District." After the Flowering plants and Ferns is a list of Mosses, Hepaticæ, and Lichens, for which, as the author informs us in a foot note, he was indebted to two very accomplished young ladies. The Flowering plants and Ferns are 122 species, whether from original observations of Mr. Addison, or by whom communicated, there is no evidence to show. Certain it is that out of the 122 species all but 8 were published by Mr. Lees two years previously in the catalogue to "Hastings' Illustrations," and many of these in "Loudon's Magazine, 1830." Two more are marked "Lees' Cat." in Watson's "New Botanists' Guide," 1835. The remaining 6 are *Spergula arvensis*, *Angelica sylvestris*, *Senecio lividus*, *Mentha Pulegium*, *Holcus mollis*, *Poa nemoralis*.

Spergula arvensis was noted as a Malvern plant by J. K. Walker, "Medical and Surgical Reporter," 1828; *Mentha Pulegium*, by Stokes (*fide* Ballard), 1787; *Angelica sylvestris* was noted as a Worcester plant by Pitt, 1810; *Senecio lividus*, Sm., is a form of *S. sylvaticus*, noted by Purton, 1817; *Holcus mollis* was noted by Edwin Lees, "Stranger's Guide," 1828; *Poa nemoralis* I believe to be a new county record, to be placed to the credit of Mr. Addison.

In the year 1837 there appeared the first volume of a serial called "The Naturalist," conducted by B. Maund, F.L.S., and W. Holl, F.G.S. It contains a paper by Robert J. N. Streeten, M.D., entitled "Observations on the British species of *Myosotis*." Mr. Towndrow informs me that at page 173 *M. collina*, Hoffm., is stated to occur "near Hagley, Worcestershire." I am not aware whether any subsequent volumes were published. Mr. Benjamin Maund was the author of an illustrated work on foreign plants, entitled "The Botanic Garden."

(*To be continued.*)

A CHAPTER IN THE PHYSICAL GEOGRAPHY OF THE PAST.

PRESIDENTIAL ADDRESS
GIVEN TO THE BURTON-ON-TRENT NATURAL HISTORY
AND ARCHÆOLOGICAL SOCIETY.

BY HORACE T. BROWN, F.G.S., F.I.C., F.C.S.

(*Continued from page 251.*)

But the rock has undergone a great change between Derbyshire and Charnwood. Instead of the thick, massive beds of limestone, of which we have never seen the base, and which must be at least from 4,000 to 5,000 feet thick in North Derbyshire, we find a rapid tailing off in thickness as Charnwood is reached; a tailing off which at Grace Dieu, only 20 miles south of the Derbyshire hills, *has reduced the thickness to about 40 feet*. At the same time the rock loses somewhat its purity, and becomes rather more earthy in character, but there is no intercalation of sandy beds. At Ticknall, as some of you will remember, we have unmistakable evidence of the shelving nature of the bottom upon which the limestone was deposited.

Taking all the evidence together, there can be no doubt that we are approaching once more a *coast line*, for the attenuation of the Mountain Limestone cannot be due to denudation, since we find it overlaid by the Limestone Shales and Millstone Grit.

This new southern land must have been of an entirely different character from the continent bounding the sea to the north. That there must have been clear water nearly close up to the shore is proved by the existence of an organically formed limestone very near the old coast line. That the land must have been of too small an extent to give rise to any

great streams, is shown by the absence of any material incoming of sedimentary strata as the southern shore is approached. This southern land was in fact an *island* bounded by a rocky coast. Of this island the northern portion of the Charnwood area was part, and there is not much difficulty by the aid of natural exposures, and by the results of borings, in determining approximately its extent and shape. It must have been long, narrow, and rocky, and extended from what is now the east coast of Ireland, through the Central Midlands, to an indeterminate point eastward.

The proof of this is afforded by the following facts:—At Coalbrook Dale, in Shropshire, we find an attenuated representative of the Mountain Limestone, very similar to that of Grace Dieu, of the same earthy character, and having about the same thickness. This must also have been a shore deposit, and a line drawn through these two places, which are fifty miles apart, cannot deviate far on either side from the old coast line, which must have had a general trend a little south of west. South of this line lies the Coalfield of South Staffordshire, in which the Coal Measures rest directly upon the older Palæozoic rocks, with the intervention of the Mountain Limestone, so that we are quite sure that the sea in which this latter was deposited did not extend so far south.

From the neighbourhood of Coalbrook Dale the old coast bent round somewhat to the north, for it must have run to the east of the tract occupied by the Shrewsbury Coalfield, where, just as in South Staffordshire, the Mountain Limestone is absent under the Coal Measures. Mantling round the hilly district of North Wales are undoubted beach deposits of Lower Carboniferous age, and by means of these we can trace, with close approximation to accuracy, the old shore line in its course northward and westward between Anglesea and the mountains of Snowdonia to the margin of the Irish Sea.

The western limit of the old island was doubtless where are now the mountains of Wicklow in Ireland, and its southern coast is clearly marked for some distance across South Wales.

On its southern side, in what is now South Shropshire, was a deeply cut little inlet or bay, the existence of which is indicated by the small outlying representatives of the Carboniferous Limestone in the Cleve Hills. That there was land on the eastern side of these hills is shown by the Coal Measures of the Forest of Wyre resting on the older rocks, without the intervention of any members of the *Lower Carboniferous*. From this point to Northampton, almost due

east, we have no direct evidence to guide us, but at or near the latter place a series of borings through a great thickness of the overlying Secondary Rocks has proved the existence of a sandy and degenerate representative of the Mountain Limestone, thinning out northwards against land rising rapidly in that direction.*

It can be shown by a similar line of reasoning that these old Carboniferous seas, which spread over the greater part of the southern and northern portions of our country, were really arms or inlets of a far larger sea which extended throughout the greater part of Northern Europe, far into Russia. Scandinavia formed part of the great northern continent, and from this, as well as from the south, the rivers were constantly bringing down into this island-studded inland sea their freight of sand and mud, whilst in the deeper and clearer portions limestone was being formed.

As the limestone thickened, filling the hollows in the sea bottom, the water necessarily shallowed, and the deposits of sand and mud, which were originally confined to near shore, invaded the now shallowed areas, and gradually, though at first intermittently, rendered the water unfit to support the life of limestone-building organisms.

We can readily understand how, by slowly alternating conditions, sometimes impure limestone, and sometimes mud and sand were deposited over the same areas. These are the conditions under which the *Yoredale Rocks*, the next in upward succession to the Mountain Limestone, were formed. But it is certain that these muds and sands, and the still coarser sediments of the Millstone Grit which followed them, were deposited in a slowly subsiding area. We have seen how the sandy deposits around our present coasts are laid down in comparatively shallow water, and it is manifestly impossible to explain the existence in the Carboniferous rocks of thousands of feet of shallow water deposits, deposits which could scarcely have been made in water deeper than 100 to 200 feet, without supposing subsidence of the bottom to have taken place concurrently with the throwing down of the coarse sediment.

That a subsidence of this kind actually did take place is shown by the fact that each member of the Carboniferous Series creeps over the edge of the deposit below it. The Millstone Grit, for instance, extends beyond the original boundaries of the Mountain Limestone, and the Coal Measures

* Some of the rocks forming this old land have been shown by Professor Bonney to be identical with certain Charnwood Rocks. J.G.S., 1885 Proceedings, p. 48.

again beyond those of the Millstone Grit. This is the phenomenon of *overlap*, which has been so largely made use of in determining the original boundaries, or in other words the *coast-line* of any particular member of the Series.

Up to the present time we have been dealing with sedimentation which took place in salt or brackish water; but, after the deposition of the masses of sandstones and shales of the Millstone Grit, the great Inland Seas, now so shallowed by coarse sandy shoals and mudbanks, became wholly or partially cut off from the ocean, and the water threw down finer sand and clay. We now begin to find traces of old land surfaces, which ever become more and more frequent. Subsidence was still going on, but slowly and intermittently, and the fine clay deposits of the alluvial flats were often for long periods together so near the surface of the water as to support a thick mass of vegetation, the remains of which we now have in our Coal Seams.*

In order to find anything at all approaching the morasses which covered a great part of the surface of the British Isles, and of Northern Europe, in the Coal Period, we must look to the gloomy cypress swamps of the Mississippi. In the Great Dismal Swamp accumulate immense thicknesses of vegetable matter, the product of generation after generation of growing trees and semi-aquatic plants. These masses of peaty matter owe their wonderful freedom from any admixture of sand or silt, to the filtering agency of the marginal belt of reeds and brushwood, which effectually prevents any sediment from mixing with the vegetable mass. Doubtless some such cause as this produced the extraordinary purity of some of our coal seams.

In picturing to ourselves the appearance of those huge, swampy flats of the Coal Period, which covered hundreds of thousands of square miles, we must not imagine a forest growth like that of the present day. The predominating forms, and those whose remains had most to do with coal-forming were *Cryptogams*, and consisted of trees related to our Lycopods or Club Mosses, and to our Equiseta or Horse Tails. These acquired proportions which were truly gigantic as compared with their lowly and degenerated modern repre-

* These land deposits seem to have taken place in the deltas of large rivers, even at a very early period in Carboniferous times, for thin beds of coal are found in Northumberland in sandy and detrital deposits, which are actually contemporaneous with the Mountain Limestone of the Midlands; it is manifest, however, that these could have had but a local extension, and that the conditions favourable for the growth of vegetation over extensive areas were long subsequent.

sentatives. The ferns were mostly of the herbaceous kinds, but some large Tree Ferns also existed, far outstripping in height the noble Tree Ferns of our tropical islands. We look in vain for the higher orders of the flowering plants, for the Phanerogams were only represented by their lowest order the Gymnosperms, which included some Conifers, and a few Cycads. These dense and tangled brakes were not without animal life, for we have found in the Coal Measures remains of scorpions, spiders, cockroaches and crickets. The Coleoptera were also represented, but, as far as we know at present, the Lepidoptera did not yet exist; nor is this to be wondered at when we consider the entire absence of the higher flowering plants. In the waters were numerous fish, but the only known air-breathing Vertebrates were Amphibia, of which the Labyrinthodonts, huge frog-like animals, were the chief. These are known to us principally by the curious hand-like footmarks which they left upon the mud.

The remains of these great sub-tropical forests must have formed originally very thick masses of peat, probably ten or twenty times thicker than the coal seams they were destined to become. This peat consisted, for the most part, of the decomposed cellular tissue of plants which grew upon the spot; and, within the last few years, we have had a curious piece of evidence to show that the initial decomposition of the tissue was effected, not by the mere chemical action of air and moisture, but by the agency of those minute living organisms which we now recognise as playing such an important part in all putrefactive and fermentative change. That there are some of you here to-night who are specially interested in bacteriology, must be my excuse for referring somewhat at length to this interesting fact which, as far as I know, has not yet found its way into text-books.

In the year 1879 Van Tieghem announced to the French Academy of Sciences that he had discovered in certain microscopic sections of plants from the Coal Measures of Saint Etienne, undoubted traces of a minute organism well-known to bacteriologists as *Bacillus Amylobacter*. This *Bacillus* is very active in the destruction of the cellulose of vegetable tissue, and is identical with Pasteur's butyric acid ferment. So we see that in the marshes of the Coal Period plants underwent decomposition by identically the same agent as they do at the present day, and that even at this very remote time, probably separated from our day by millions of years, this *Bacillus* was at work partially destroying the dead tissues of the higher plants, and facilitating their conversion into coal for our use. This is the only well authenticated

case, as far as I know, of the discovery of a fossil bacterium,* and it is a suggestive fact that, whilst in course of untold ages its contemporaries high up in the scale of existence have undergone enormous change, this lowly organism is to-day both morphologically and functionally what it was in the Coal Period.

In order that you may picture to yourselves the relation of land and water in the British Islands during the Coal Period, I must refer you once more to the map of Lower Carboniferous times. You must imagine that all the area marked as sea has been converted into very shallow water or swampy ground, and that these lagoons have somewhat encroached upon the old shore lines, thus reducing the area delineated as land on the map. The great Central Island still existed, but it was narrowed somewhat, and perhaps also split up into a chain of two or three islands. The Southern Uplands of Scotland, which stood above the water in Lower Carboniferous times, were now submerged, and the island of the Lake District became much smaller. Still, on the whole, the general distribution of the land was pretty much as it was when the Carboniferous Limestone was deposited, and this must have been occasioned by the land areas not participating to the same extent as the sea bottom in the slow downward movement which admitted of the accumulation of so many thousand feet of strata.

This is sufficiently indicated in the case of the Central Island, by the great thinning out of all the strata as we approach its northern shore. The Coal Measures, for instance, in our Ashby Coalfield are about 2,500 feet thick, and probably were originally 3,000 feet; these as they approached the barrier ridge southward have thinned out in North Warwickshire within a distance of only 12 or 14 miles to 600 feet.

But we have independent testimony to the fact that the land of our Central Island was comparatively stationary whilst the sea bottom was subsiding, and that the amount of subsidence increased from the Island towards North Derbyshire. This evidence, to which but little or no attention has hitherto been paid, is as follows:—

In our Ashby Coalfield the largest and most valuable seam is that known as the *Main Coal*, which consists of two beds, the Over and the Nether Coal, with a thickness of 5 and 7 feet respectively. In the northern part of the Coalfield

* Béchamp's observations on his supposed fossil microzyme of the chalk—*Microzyna cretæ*—have been found to be erroneous.

these coals are separated by as much as 60 feet of sedimentary strata, but when traced southwards they are found to come rapidly together, and, at the Moira Colliery, form a single undivided bed of about 14 feet thick. Now we know from the conditions under which coal has been formed that the beds must have been laid down on a perfectly horizontal surface. After a sufficient thickness of peat to form the Nether Coal had accumulated, subsidence must have been commenced, which gradually increased in amount towards the north, and thus effectually prevented the continued growth of the peat bed in that direction, whilst in the south the growth was uninterrupted. By and by subsidence ceased, and allowed the forest growth which was to produce the Over Coal to spread once more over the whole area. In this way only can we account for the splitting up of a coal bed.

Both in the Warwickshire and in the South Staffordshire Coalfield we find this splitting up of the Coal Seams even more marked than it is in our district, and the splitting up in both cases takes place, as in our Ashby Coalfield, *towards the north*. In the South Staffordshire district, in the neighbourhood of Dudley, the ten yard Coal, as it is called, is an undivided seam thirty feet thick; but when traced northwards within a distance of a few miles it divides into *nine* distinct seams, separated by an aggregate thickness of 420 feet of Sandstone. The combined thickness of these nine seams of Coal is only a little short of the original thickness of the undivided seam, so that besides having here a good example of horizontally progressive and intermittent subsidence, we have an indication of the extreme slowness with which the peat beds must have increased in thickness. The time taken to accumulate 420 feet of sedimentary strata was only sufficient to add at the outside a foot or two to the thickness of the coal seam.

(*To be continued.*)

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, B.A., AND J. E. BAGNALL, A.L.S.

(*Continued from page 260.*)

Sub-genus X.—VOLVARIA.

153. **Ag. volvaceus**, Bull. Stoves. Rare. July. Cucumber frame, Rev. E. H. Knowles, Kenilworth, July, 1871, *Russell, Illustr.*

154. *Ag. speciosus*, *Fr.* Dung-hills. Rare. Oct. Crackley Wood, Kenilworth, *Russell, Illustr.* Lane near Hams Hall. on waste heap. [Also near Sutton Park, but in Staffordshire.]
155. *Ag. gloiocephalus*, *DC.* On the ground. Rare. Kenilworth, *Russell, List.* Near Brinklow, *Adams.*
156. *Ag. parvulus*, *Weinm.* Pastures. Rare. Oct. The Moats, Ansty; Shilton field, *Adams.*

Sub-genus XII.—PLUTEUS.

157. *Ag. cervinus*, *Schæff.* *Ag. latus*, *With.* On the trunks of trees. Aug.-Oct. Frequent. Edgbaston, on turf, *With.*, 227. At the base of a dead pear tree, Kenilworth, *Russell, Illustr.* Withybrook, near Brinklow, *Adams.* Driffold Lane; Sutton Park; New Park; Packington Park; Solihull; Olton; Marston Green; Grove Park, Warwick; etc.
- Var. *patricius*, *Schulz.* May-Sept. Shilton, near Coventry, *Adams.* Driffold Lane, Sutton.
- Var. *eximius*, *Smith.* Rare. Warwick Castle Grounds, *Perceval.* Kenilworth, *Russell, Illustr.*
158. *Ag. umbrosus*, *Pers.* Dead trunks. Rare. Stoneleigh Deer Park, *Russell, Illustr.*
159. *Ag. nanus*, *Pers.* On stumps. Rare. Four Oaks Park; Sutton Coldfield.
160. *Ag. chrysophæus*, *Schæff.* On wood. Rare. May-Sept. Warwick Castle timber yard, *Perceval.* Amongst sticks, Crackley Wood, Kenilworth, *Russell, Illustr.* Hopsford, near Brinklow, *Adams.*
161. *Ag. phlebophorus*, *Ditm.* *Ag. reticulatus*, *With.* On sticks. May-Aug. Edgbaston Pool Dam, *With.*, 283. Shilton, near Coventry, *Adams.* Sutton Coldfield.

Sub-genus XIII.—ENTOLOMA.

162. *Ag. sinuatus*, *Fr.* Woods. Rare. Sept. Wedgenock Park, *Perceval.* High Down, near Combe, *Adams.* Wood at Walmley; Crackley Lane.
163. *Ag. prunuloides*, *Fr.* On the ground. Rare. Aug. Coleshill Pool.
164. *Ag. repandus*, *Bull.* Very rare. Kenilworth, *Russell, List.*
165. *Ag. ameides*, *B. and Br.* Pastures. Rare. Ansty Fields, *Adams.*
166. *Ag. Saundersii*, *Fr.* On the ground, Shilton, near Coventry, *Adams.*

167. **Ag. jubatus**, *Fr.* Roadsides, in grassy places. Rare. Marston Green; near Barnt Green, on boundary of outlying portion of the county; *Cooke, Illustr.*, pl. 317, exactly.
168. **Ag. griseo-cyaneus**, *Fr.* Fields. Rare. Hopsford, near Brinklow, *Adams.*
169. **Ag. sericellus**, *Fr.* Woods. Rare. Sept. Dalehouse Lane, Kenilworth, *Russell, Illustr.* Marston Green; Trickley Coppice.
170. **Ag. clypeatus**, *L.* Gardens. Rare. Apr.-May. Red Lane, Kenilworth, May, 1865; gardens, Kenilworth, April, 1872, *Russell, Illustr.* The Moats, Ansty, *Adams.*
171. **Ag. rhodopolius**, *Fr.* Moist woods. Aug.-Oct. Under trees, Birmingham Road; Crackley Wood, Kenilworth, *Russell, Illustr.* Hopsford, *Adams.* New Park, near Middleton, *Dr. Cooke.* Small wood, near Penns railway station; Trickley Coppice.
172. **Ag. costatus**, *Fr.* Meadows. Rare. Sept. The Spring, Kenilworth, *Russell, Illustr.*
173. **Ag. sericeus**, *Bull.* Meadows. Sept.-Oct. Red Lane and Birmingham Road, near Kenilworth, *Russell, Illustr.* Ansty, near Coventry, *Adams.* Marston Green; Corley; Sutton Park.
174. **Ag. nidorosus**, *Fr.* Woods, etc. Oct. Crackley Wood, Kenilworth, *Russell, Illustr.* High Wood, Combe, *Adams.* New Park and Trickley Coppice, Middleton, *Dr. Cooke.* Newlands Wood, near Hatton; coppice in Packington Park.

Sub-genus XIV.—CLITOPILUS.

175. **Ag. prunulus**, *Scop.* *Ag. pallidus*, *Purt.* Woods, etc. Local. Oct. On a hedgebank at Oversley, *Purt.*, iii., 183. Pasture, Kenilworth, *Russell, Illustr.* The Ridings, Combe, *Adams.* Baddesley Park, *Hawkes!* Sutton Park; banks of a small pool near Packington Park.
176. **Ag. undatus**, *Fr.* Pastures. Rare. Kenilworth, *Russell, List.*
177. **Ag. carneo-albus**, *With.* Very rare. Aug. Oversley Hill, *Purt.*, ii., 625.

Sub-genus XV.—LEPTONIA.

178. **Ag. lampropus**, *Fr.* Grassy woods. Rare. Sept. Bentley Park, *Bloxam.* Corley, *Adams.* Pine wood, Coleshill Heath; near Coughton Park.
179. **Ag. serrulatus**, *Pers.* Amongst grass. Rare. Sept. Corley Woods.

180. **Ag. euchrous** *Pers.* On stumps. Rare. Hopsford, near Brinklow, *Adams*.
 181. **Ag. chalybæus**, *Pers.* Grassy woods. July-Sept. Combe Ridings, 1882; Sutton Park.
 182. **Ag. incanus**, *Fr.* Pastures. Rare. Fields, Ansty, *Adams*.
 183. **Ag. asprellus**, *Fr.* Pastures. Rare. Pastures, Corley! *Adams*.

Sub-genus XVI.—NOLANEA.

184. **Ag. pascuus**, *Pers.* Pastures and waysides. Common. Aug.-Oct. Grassy spot, Crackley Wood; meadow, near Kenilworth, *Russell, Illustr.* Mill field, Ansty, *Adams*. School Close, *Rugby Sch. Rep.* By Trickle Coppice; Marston Green; Sutton Park; Four Oaks; Sutton; Langley; Edgbaston Park; Packington Park; Coleshill Pool; Corley; near Coughton Park, etc.
 185. **Ag. mammosus**, *Fr.* Grassy places. Rare. Oct. Pine wood, Coleshill Heath, 1884.
 186. **Ag. pisciodorus**, *Ces.* Amongst grass and leaves. Rare. Feb., Oct., Dec. Driffold Lane, Sutton.

Sub-genus XVIII.—CLAUDOPUS.

187. **Ag. variabilis**, *Pers.* On sticks. Rare. Oct. On blackthorn, Kenilworth, *Russell, Illustr.* Hopsford, near Brinklow, *Adams*. Sutton Park, on sticks.

Sub-genus XIX.—PHOLIOTA.

188. **Ag. durus**, *Bolt.* Cultivated land. Rare. Aug.-Sept. Dunn's Pit Lane; field, Birmingham Road, near Kenilworth, *Russell, Illustr.* Ansty, *Adams*.
 189. **Ag. præcox**, *Pers.* Fields and gardens. Feb.-July. Warwick, *Perceval*. Garden, Kenilworth; Dale House Lane; borders of Crackley Wood, Kenilworth, *Russell, Illustr.* Hopsford; Ansty, *Adams*. Edgbaston; Erdington; Sutton; Water Orton; near Oldbury Reservoir; Kenilworth; Packington Park.
 190. **Ag. radicosus**, *Bull.* Woods. Rare. Oct. High Woods, Combe, *Adams*. Pine wood, Coleshill Heath.
 191. **Ag. pudicus**, *Bull.* Stumps. Rare. Oct. Elder stumps, Ansty Churchyard, *Adams*.
 192. **Ag. heteroclitus**, *Fr.* On butt end of logs. Very rare. Oct. Driffold Lane, Sutton; occurring many years in succession, always cæspitose, large and fine specimens, exactly like *Cooke, Illustr.*, pl. 366.

193. **Ag. squarrosus**, Müll. On trunks of trees. Sept.-Oct. *Ag. floccosus*, Edgbaston, *With.*, 262. Studley Castle, *Purt.*, ii., 645; Allesley Bree in, *Purt.*, iii., 416. Hams Hall, *Hawkes!* Combe Fields, *Adams.* Sutton; The Grange, Erdington; near Penns railway station; Kenilworth; Trickley Coppice; Lady Wood, Four Oaks; etc.
194. **Ag. spectabilis**, Fr. On dead stumps. Oct. *Ag. aureus*, at Oversley, Wixford, and near Broome Court, *Purt.*, iii., 195. Warwick, *Perceval.* Kenilworth, *Russell, Illustr.* By the side of Brinklow Lane, *Adams.* Coleshill Pool; Edgbaston Park; pine wood, Coleshill Heath; Shustoke. *Ag. rheoides*, on hawthorn and alder stumps, Edgbaston Park, and Lane to Curdworth, *With.*, 210, seems to be this species.
195. **Ag. adiposus**, Fr. On trunks of trees. Oct. Stump, Malt House Lane, Kenilworth, *Russell, Illustr.* Hopsford, *Adams.* Driffold Lane, Sutton.
196. **Ag. mutabilis**, Schæff. On stumps. Local. Aug.-Oct. Edgbaston, on rotten wood, *With.*, 279. Hopsford, *Adams.* Driffold Lane; Sutton Park; Langley; New Oscott; New Park; Trickley Coppice; pine wood, Coleshill Heath; Alveston Pastures.
197. **Ag. marginatus**, Batsch. Woods. Rare. Oct. In the Park at Packington, *With.*, 283. The Spring, Kenilworth, *Russell, Illustr.* Pine wood, Coleshill Heath; Wyndley Pool, Sutton.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Continued from page 265.)

Agricultural drainage does not cause floods, neither does it materially diminish the supply of water to porous beds, according to some authorities. The question is very difficult to deal with, because very strong and quite opposite opinions are held on the subject. So far as I can judge, farmers, as a class, hold the opinion that under-draining does not help to cause floods, but rather to diminish them, whereas engineers generally hold the opposite opinion. The line of argument taken by the former seems to be about this:—The more thoroughly a soil is under-drained, the more nearly does it resemble a dry sponge in absorbing water, and the less likely is any to flow

off the surface in open watercourses, and so assist in producing floods. It is asserted that such under-draining would tend to diminish floods by deferring the discharge of water from the land in the manner indicated.

The heavy floods of the few years preceding 1884, in Northamptonshire, are attributed to want of drainage rather, for there was then more land wanted draining than there had been for twenty years previously, and this largely because the heavy rains had burst up the drains, and they wanted relaying. The depth to which rain must sink before the drains can act, the slowness of discharge from drain pipes compared with surface discharge, also the large amount of porous upland—estimated at not less than one-third for the district we are particularly concerned with—neither requiring nor having any artificial aids to discharge its water, are pointed to as evidence of the small effect land drainage can have had in increasing floods.

The exact manner in which drains act gives rise to difference of opinion, this probably depending upon the character of the land with which each person is best acquainted. Where a comparatively porous bed rests on an impervious one at a small depth below, the drain pipes will receive most of their water upwards, after the lower portion is saturated; in most other cases the saturation plane would travel downwards rather.

As to whether drainage diminishes percolation sufficiently to seriously interfere with springs from underlying porous beds, it is pointed out that although districts with a deficiency of water are often those where drainage has been most extensive, still the very fact that such drainage is necessary shows that impervious beds constitute the subsoil, and so percolation would be small.

I have already given reasons for the opinion that the marlstone water supply has not been seriously diminished by land drainage.

That land drainage does help to cause floods is, however, a justifiable conclusion, I think, and the chief reasons for this opinion are detailed below:—On stiff, undrained, and badly cultivated land water will stand in the furrows, and everywhere where a concavity exists, for days, and even weeks at some parts of the year, and only get away very slowly indeed by dribbling through weed choked ditches, by percolation into the ground when the water previously there permits it, or by evaporation. Compare this with the condition of well cultivated land, where the watercourses are kept free, and every facility given for the water to rapidly get away, and it

will be evident that the higher cultivation of recent years, of which tile draining is an essential concomitant, must tend to discharge water more rapidly into the valleys. Drainage has for its object the rapid removal of surplus water, and, if it does not do this more quickly than nature, it is difficult to guess its use ; it cannot even convert the land into a sponge without first ejecting the water from such land.

The prevalence of the opinion that drainage causes floods is shown by the provision in the Rivers Conservancy and Floods Prevention Bill, brought forward in 1883, for taxing the uplands to the extent of one-tenth for improvements in the lowlands. Whether this was just or not, and whether the assumed proportion of responsibility for floods was satisfactory, I will not pretend to say, but the bill had been preceded, a few years before, by an examination of witnesses before a committee of the House of Lords. These witnesses, although differing much as to the causes of floods, were fairly unanimous in the opinion that floods were more common and higher than formerly, though in some cases they did not last so long.

Efficient draining permits farm work to be renewed very soon after the cessation of rain, and almost always within the limits of time represented by the commencement and termination of the flood, supposing the rainfall sufficient to cause such, and if so, the water removed must have been added to that reaching the valley otherwise, and so assisted in causing and increasing that flood.

The sponge theory of drainage chiefly applies to periods in which the rains are separated by intervals of dry weather, for instance summer time, when a considerable rainfall is required to produce floods at all. Drainage alone will never desiccate the soil ; the moisture held by capillary attraction will not be removed at times when the humidity of the atmosphere prevents evaporation, hence rapidity of action in the drains is essential for the soil and subsoil to have any absorptive capacity under such conditions, and these are the most natural conditions during the winter flood period.

Properly laid drains do very promptly begin to act after rain, and herein lies the chief disadvantage incident to drainage. The water is so rapidly carried away when from other sources there is plenty, that much less is left for sustaining the springs in summer. Unless the drains are laid very deep in a stiff soil, or the area drained is large compared with the number of drains in it, they will cease to act about May, whereas natural springs, supplied by the same winter rainfall, will often continue to improve during the

summer, and be at their best in the following autumn. To the causes just referred to must be attributed the complaints of old millers, who depend chiefly or entirely on water, that they have a more frequent alternation of flush and slack water now to contend with than they did, both of which are harmful to them.

There can be no doubt that there is less evaporation from well drained land than from undrained; also that there is more percolation into it. If more water goes in because more has been drained out, the same amount of water reaches the main streams, and as to whether it tends to produce floods or not is a question of time only. The difference between the evaporation from undrained and drained lands is a direct and considerable gain of water which, sometime, must find its way into the valley. To this quantity must be added or subtracted any water that would be arrested in its downward passage to a water-bearing bed, as a cause affecting flood and slack water, if it be allowed that drainage is chiefly operative during flood periods.

What has been said about agricultural drainage does not materially affect the question as to whether the floods of recent years, in the Nen valley, were more violent or more frequent because of more efficient or more extensive drainage—the main cause we all know was excessive rainfall—but refers chiefly to the broader one as to whether floods are at any time increased by land drainage.

The main object of the preceding remarks on agricultural drainage is to show that a great quantity of water is allowed to run away and help to produce floods. This water with a little extra trouble might often be made to feed the porous beds of the district, as I have proposed to feed the marlstone, and so be of immense benefit for the supply of villages throughout the summer, besides somewhat equalising the flow of the river.

(To be continued.)

R e v i e w .

The British Moss Flora. By R. BRAITHWAITE, M.D., F.L.S. Part XI. Fam. X., Grimmiaceæ I. Royal 8vo. 8s. L. Reeve and Co.

THIS is the commencement of the second volume of Dr. Braithwaite's valuable work on the British Mosses, and is of special interest, as forming a complete monograph of the British species of *Grimmia* and its allies. The part is illustrated by eight plates, giving not only a life-size illustration of each plant, but also magnified representations of all the various parts of each plant, all drawn with the singular

fidelity and exquisite finish peculiar to the author. Beside these, there are fifty-six pages of letterpress, in which we have full and graphic descriptions of each plant, together with those additional familiar notes that are frequently so helpful in difficult and critical groups. The part is one of the ablest and most chastely illustrated portions of the author's great work. We look forward with interest to the publication of Part XII., in which we are promised a full treatment of the genera *Orthotrichum* and *Schistostega*, the former being probably one of the least understood groups of our British mosses.—J.E.B.

Wayside Note.

WASPS IN 1888.—Doubtless most of us have noticed that the past season has been very remarkably free from wasps (the writer has not seen or even heard of a single wasp's nest being found in the Midlands). But during the past few weeks of bright sunshine (October) many queen wasps have made their appearance, as though the cold wet season had prevented their establishing nests in the usual way at the usual period. We presume that those queens which will escape annihilation this autumn will appear again next year to propagate the species, provided the weather is suitable. W. S. G.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—BIOLOGICAL SECTION.—October 9th, 1888, Mr. R. W. Chase in the chair. The following were exhibited by Mr. W. B. Grove, B.A.:—Fungi collected during the fungus foray in Sutton Park, including *Agaricus terreus*, *Ag. personatus*, *Cortinarius pholideus*, *C. delibutus*, *C. erythrinus*, *Hygrophorus hypothejus*, *Mitrella paludosa*, *Corticium sanguineum*, all new to Sutton Park or district; for Miss Gingell, *Cantharellus cibarius*, *Craterellus cornucopioides*, *Agaricus æruginosus*, and other fungi from Dursley, Gloucestershire; by Mr. Edmunds, *Peziza aurantia*; by Mr. W. R. Hughes, F.L.S., for Mr. Jones, of Sutton Coldfield, *Blatta Lapponica*. Mr. W. P. Marshall read his paper on "Norway Plants," recently collected by himself and Mr. C. Pumphrey, in which he gave an interesting account of the voyage out to the North Cape, the various places visited *en route*, and a vivid description of the glorious phenomenon of the midnight sun. The paper was illustrated with 150 specimens of plants, collected at the various stopping places, and two excellent maps, one of the West Coast of Norway from Bergen to the North Cape, and the other of the Arctic Circle. On the latter was traced the line of lowest mean temperature, showing how this line was displaced 600 miles north of the normal position at the North Cape by the influence of the Gulf Stream.—GEOLOGICAL SECTION.—October 16th, Mr. T. H. Waller, B.A., B.Sc., in the chair. In response to an invitation from the Council to the members of the Vesey Club (Sutton) to attend this, the opening meeting of the Section, several members of that Club were present. After a cordial welcome had been given to the visitors by the Chairman, the following were exhibited:—Mr. W. B. Grove, *Ag. mastoides*, *Ag. clavipes*, and *Hygrophorus puniceus*, from Dawlish; *Russula virescens*, *R. nigricans*, *Ag. spadiceus*, from Umberslade; Mr. F. Enock, Specimens of Puparia of the Hessian Fly (*Cecidomyia destructor*), *in situ*, in wheat stubble, from

Acocks Green Farm; Mr. J. E. Bagnall, for Miss Gingell, Fungi, *Helvella crispa*, *Cortinarius largus*, *Craterium pedunculatum*, *Hydnum repandum*, and other fungi, from Dursley, Gloucestershire; also several mosses; for Rev. D. C. O. Adams, *Hygrophorus pudorinus*, *Clavaria condensata*, *Cortinarius Berkeleyi*, from Crowell, Oxon. The chair was then taken by Mr. R. W. Chase, during the reading of Mr. Waller's paper on the Rock Specimens recently brought from Norway by Mr. C. Pumphrey. The Rock Specimens were principally gneisses, schists, and pebbles. Considerable interest was excited by the paper, which was illustrated by microscopical sections. Several members and visitors took part in the discussion upon the topics referred to in the paper. Mr. J. B. Stone, on behalf of the Vesey Club, expressed the great pleasure felt by that Club in receiving so warm an invitation from the Natural History Society, and hoped to have the still greater pleasure of receiving the members of the Natural History Society as the guests of the Vesey Club at no very distant date. Professor Lapworth, after personally thanking Mr. Waller for his valuable paper, gave the Section an invitation to the opening address of the Geological Section of the Philosophical Society, to be delivered at the Medical Institute on October 25th, on "The Geology of the Future."

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—September 24th. Mr. W. H. Bath exhibited the larva of *Libellula quadrimaculata*; Mr. J. Madison, specimens of *Anodonta anatina* var. *complanata*, from King's Heath; Mr. J. W. Neville, tropical varieties of Helices. Mr. C. P. Neville then read a paper—"Notes on the Vale of Llynant." The writer illustrated the scenery of the vale by a series of sketches, and described its geological, botanical, and entomological features. Insect life was very abundant, four kinds of fritillaries being taken in a few yards. The writer gave lists of the insects captured, and recommended those who love a ramble in Nature's quiet haunts to visit central Wales.—October 1st. Mr. P. T. Deakin exhibited a strangely distorted specimen of *Planorbis complanatus*; Mr. H. Hawkes, under the microscope, *Bulgaria inquinans*, from Hamstead, and *Peziza coronata*, from Knowle; Mr. J. Collins, section of sporocarp of *Pilularia globulifera*.—October 8th. Mr. P. T. Deakin exhibited a collection of marine shells from Malta; Mr. J. Moore, a series of photo-micrographs of parts of insects. Mr. W. H. Bath then read a paper on "Extinct British Butterflies." The writer said the greater part of animals were only found within well-defined limits, no two countries or districts being absolutely identical, and the circumstances that had brought about changes in the past were still exerting their influence on living forms. The butterflies of England only numbered sixty-five species, whilst Continental species were four times as numerous. The writer referred to species that were extinct, *Papilio podalirius* having disappeared within the last century; *Papilio machaon*, once widely distributed, is now only found in the south-east; *Erebia Cassiope* was said to have been with us from the glacial period. An interesting paper was concluded by dealing with the causes that produced the changes, and which were found in physical geography, climate and vegetation.—October 15th. Mr. W. H. Bath exhibited a collection of insects of the order Planipennia made in the Birmingham district; Mr. Barrowdale, a specimen of *Atticus illyllita*, a silkmoth from Bengal, also a number of preserved larvæ and cocoons of British moths; Mr. J. Madison, a distorted specimen of *Planorbis complanatus*, in which the spiral assumed a corkscrew form. Under the microscope, Mr. H. Hawkes showed the following fungi:—*Craterium leucocephalum* and *Physarum nuntans*; Mr. J. W. Neville, a curious plant bug (*Tingis*) from Turkey.

PHILIP HENRY GOSSE, F.R.S.

This eminent Zoologist, who was indubitably one of the most popular—if not one of the greatest—Naturalists that Britain has produced in this nineteenth century, “peacefully passed away in his sleep,” on the morning of Monday, 23rd of August last, in the 79th year of his age, after an illness of five months. “Peacefully passed away in his sleep!” The words, viewed by the light of after events, seem to have been almost prophetic. The writer of these lines, who was honoured by his friendship during many years, and who, in common with many others, deploras the loss of a true friend, and the still greater loss which science has sustained by his “passing away,” recalls a memorable conversation that took place, in the garden of his quiet and beautiful home, at “Marychurch,” now nearly a quarter of a century ago. The topics on which we had been discoursing were of the most momentous nature—life, death, and immortality; and the question was put by the writer, “Would it at all distress your mind if you knew you were to die to-night?” The answer was immediate, clear, ringing, and decisive, “No, it would not.” Often and often since have those words been brought back to memory. How beautifully they illustrate the gentle, loving, eminently religious character of the man, and the simple and trustful faith—not unlike that of the old Puritans—in which he lived and died.

The life of Mr. Gosse, which exceeded the three-score years and ten of man, was numbered both by its years and by its activities. Born at Worcester on 10th April, 1810, being the second son of a miniature painter named Thomas Gosse; educated at Blandford; serving first as a clerk in a whaler’s office in Newfoundland; then engaged as a farmer in Canada; then teaching as a schoolmaster in Alabama; and afterwards working as a professional Naturalist in Jamaica. What a rich experience. Added to it, was the inherited gift of the father’s artistic pencil, and the early enthusiasm of a kind aunt—a Mrs. Bell—who fostered and developed the boy’s taste for Natural History. And what was the result? During nearly half a century, from 1840 till 1886, a rich and varied series of works on Natural History, Microscopy, and other subjects, issued from his pen, most of which were exquisitely illustrated by his pencil. The following is a list of the more important of those which pertain to Zoology:—“The Canadian Naturalist,” 1840, “The Birds of Jamaica,” 1847,

“An Introduction to Zoology” (S.P.C.K. Society, 1848), “Popular Ornithology,” 1849, “A Naturalist’s Sojourn in Jamaica,” 1851, “A Naturalist’s Rambles on the Devonshire Coast,” 1853, “The Aquarium: An Unveiling of the Wonders of the Deep Sea,” 1854, “A Manual of Marine Zoology of the British Isles,” 1855-6, “Tenby: A Seaside Holiday,” 1856, “Life in its Lower Forms,” 1857, “Evenings with the Microscope,” 1859, “Actinologia Britannica: A History of the British Sea Anemones and Corals,” 1860, “The Romance of Natural History,” 1860-1, “Sea and Land,” 1865, “A Year at the Shore,” 1865, and “The Rotifera, or Wheel Animalcules,” 1886 (the last-mentioned work being written in conjunction with Dr. C. T. Hudson). The above list is exclusive of a large number of Papers communicated by Mr. Gosse to the Royal Society (of which he was elected a Fellow in 1856), the Linnean Society, the Zoological Society, and others. Many of the larger works were illustrated by chromolithographic plates from the author’s own drawings; but singularly beautiful as they are, they fail to give a complete idea of the fidelity to nature, which characterises the originals. Nearly all his works are rising in price, an unfailing tribute to the author’s popularity. “The Aquarium” is perhaps the scarcest of all, and, as the lithographic drawings were, we believe, accidentally destroyed some years ago, the book cannot be reproduced in its present form.

In order thoroughly to apprehend the nature and value of Mr. Gosse’s labours, as briefly recorded above, we must go back and see what was the literature on the subject of Marine Zoology at the time he did his work. Of the lower forms of Marine life—especially the Hydrozoa and Actinozoa—we knew but little. Sir John Dalzell had published two or three very expensive works on a few rare and remarkable forms, but these volumes were scarcely accessible to the student. It is true that there existed also the careful works of Dr. George Johnston (“The British Zoophytes,” &c.), which were an immense advance on either the “Zoology” of Pennant or of Shaw, but all failed in one important respect, namely, *to bring before the enquirer the various forms of Marine life as they actually lived and moved in the depths of the sea.* To quote from an obituary notice in the *Saturday Review* of September last:—“To Mr. Gosse belonged the credit of having by close and carefully recorded observations of the living creatures themselves brought order out of chaos, and led the way to a knowledge of many singular forms which until then had been impossible. But even his labours would have been attended with only limited success had he not

conceived and carried out the idea of a vivarium, in which marine animals and plants could be preserved for a lengthened period, without disturbance of the water, in a living and healthy condition, thus enabling the student to observe and record their habits from day to day, to note the varied phases of their development, their metamorphoses, and other peculiarities."

In plainer words, Mr. Gosse may be said to have almost created the Aquarium. The idea was accepted at the Zoological Society in 1852. Tanks were erected in their gardens, Regent's Park, "in which (so said the handbook issued at the time) the greater part of the British Zoophytes, Crustacea, Mollusca, and a considerable number of Fishes will, in the course of time, be exhibited." Marine Aquaria were subsequently erected in the Jardin d'Acclimatation at Paris, at Hamburg, at Naples, at the Crystal Palace, and elsewhere. In connection with these the name of the late Mr. W. Alford Lloyd must ever be associated, for the singular ability and practical skill with which he grasped the principles and carried out the practical construction of large public Aquaria. Nor in the case of the Naples Aquarium must we omit the honoured name of Dr. Anton Dohrn, who devoted his lifetime and fortune to the establishment and maintenance of that important institution. To quote the words of the *Saturday Review* again:—"Marine Aquaria at once became popular; Mr. Gosse's 'Handbook' reached a new and enlarged edition, and, while the novelty lasted, there was hardly a town in England where, by some enterprising lover of natural history, the experiment had not been repeated." Much of this enthusiasm has passed away, but the effect of it—mainly due to his genius—was to prepare the public mind for such cognate undertakings as the Dredging Expeditions of H.M.'s ships *Lightning* and *Porcupine*, and subsequently, on a still grander scale, that of H.M.'s ship *Challenger*. It is not too much to say in connection with the last-mentioned—the reports of which have regularly appeared during the last nine years, in some fifty magnificent quarto volumes, worked out by all the most eminent Zoologists in the world—that when completed it will be one of the greatest scientific results achieved by any nation at any time. Everyone will, we think, admit, that before Mr. Gosse's day an attempt by Parliament to vote a large sum of money out of H.M.'s Treasury towards such a questionable enterprise as the *Challenger* Expedition would have certainly failed! Yet another institution towards the establishment of which his labours operated as a powerful factor in the

past—Marine Biological Stations. These, which have been established at Naples, Granton, Plymouth, and elsewhere, are but the natural development from the simple Marine Aquarium, with which the names of Gosse, from the biological, and Warrington, from the chemical side, will be inseparably connected. And it is impossible to estimate the benefit which the scientific knowledge and practical good that these Stations will, by discoveries in embryological science and probably in economic fish culture, in the future develop.

To return to Mr. Gosse's work—the appearance of the “*Actinologia*,” with its gorgeously coloured, but accurately drawn plates, and faithful descriptions, was a perfect revelation. The public, and especially those who had a sufficiently cultivated taste to understand it, were until its appearance scarcely aware that such exquisite creatures lived with complicated organisation, variety of form, and brilliant colouration as therein described. Very modest indeed was his estimate of his own work. In the preface, after generously thanking those Naturalists who had assisted him by specimens, or facts, or by verifying localities, he says:—“The result is that seventy-five species find their places in these pages, five of which are merely indicated, leaving seventy good species, exclusive of the *Lucernaridæ*. Of these, twenty-four only are described in Johnston—the rest of his species being either synonyms or resting on insufficient evidence. Fifty-four British species have been examined by myself, perhaps a larger number than have come under the notice of any other naturalist; by far the greater part in life and health; and thirty-four of these have been added to the British Fauna by myself.”

In his splendid little “*Manual of Marine Zoology*,” 1865-6 (wherein there is a figure of every genus, drawn by himself, mostly from life), and which text-book is still highly valued by students, although some of its classification has been necessarily superseded by recent discoveries, he tells us the history of its origin:—“It is now about four-and-twenty years ago, that in a land far remote from this, I began the study of systematic Zoology, with Insects. It is, beyond all comparison, the most extensive class of animals, in fact, all but boundless; but in my ignorance I attacked it entire and indivisible, collecting and trying hard to identify everything that I found from the *Cicindela* to the *Podura*. I had not an atom of assistance towards the identification, but the brief, highly condensed, and technical generic characters of Linnæus's “*Systema Naturæ*,” over which I puzzled my brains, specimens in hand, many an hour . . . I have

endeavoured in the following pages to furnish, to the Seaside Naturalist, what the Linnean "Genera Insectorum" were to me. That such a book is a desideratum I need hardly say." His language in this, as in all his works, was always marvellously graceful and accurate; the definition of fishes therein is given as an illustration of what is a masterpiece of scientific acumen:—"Vertebrate animals, having cold blood; breathing by means of permanent gills; inhabiting water; furnished with fins for locomotion; producing eggs."

As previously mentioned, "The Rotifera" (one of his earliest fields of investigation) was the last work undertaken by him, with his accomplished colleague, Dr. C. T. Hudson. It is a most exhaustive monograph of immense value to Naturalists, and the microscopic drawings by Mr. Gosse, executed when he was over seventy, exhibit all the freshness and vigour of his best work.

Space will not permit of further reference to his published writings, but we think that to the general reader, with a taste for natural science, "The Devonshire Coast," "Tenby," "The Romance of Natural History," and "A Year at the Shore," will always be the most acceptable.

Nearly thirty years ago Mr. Gosse gave lectures on his favourite subject, Marine Zoology, and these are still remembered with pleasure by those who attended the lectures at the Midland Institute in Birmingham. He also for several seasons about that time held classes at Ilfracombe and elsewhere, for the practical study of that science, aided by the microscope. What a real treat it must have been to be present at those classes! The writer never had that advantage, but he has had the great privilege of being out collecting with Mr. Gosse two or three times on the south coast of Devon. To see him encased in high waterproof boots, with hammer, chisel, net, and collecting bottle in hand, wading through the retiring waves at low water, exploring every crevice in the limestone rock, and turning up from its weed-fringed surface a lovely *Eolis amethystina* (one of the Nudibranchiate Mollusca), or other delicate organism, holding it up to the light in his collecting bottle, examining it with the lens, and enthusiastically dilating upon its anatomy, physiology, and æsthetic beauty, was an event to be remembered during a lifetime. He knew everything that came in our way from the algæ up to the fishes.

Not the least among many special characteristics was his ever generous kindness and encouragement to young Naturalists. The writer of these lines owes him a deep debt of gratitude for kindly help in Marine Zoology and the

Aquarium. He also took much interest in our local Natural History Society, and frequently sent us copies of his papers. No member who ever asked him for information could complain that his questions were not promptly and exhaustively answered beyond his anticipation. The pages of this journal are enriched by two or three papers by him, notably one in volume 2, 1879, on "A Marine Aquarium." In his latter years he was a famous grower of orchids, long before they became popular, and his collection at Marychurch was at one time quite unique. He once told the writer that he had specimens, some of which flowered for a day only, and some which continued to flower for a whole year. Mr. Gosse wrote an exquisitely neat and beautiful hand, altogether of the old style, when letter writing was an accomplishment. There is a letter to the writer, dated 14th January, 1879, wherein he expresses kindly sympathy with our town in the great loss it had sustained from the destruction of the Free Library by fire. He says: "I have seen in yesterday's *Times* the terrible calamity which has befallen your valuable library, but I shall be thankful to get the fuller details, which you kindly promise to send me."

A new race of Naturalists and Thinkers has appeared since Mr. Gosse did most of his work—

"The old order changeth, yielding place to new,
And God fulfils himself in many ways,
Lest one good custom should corrupt the world"—

a race which marches under the banner of Evolution, with which Mr. Gosse had no sympathy, and who are represented by Darwin, Herbert Spencer, Huxley, Ernst Haeckel, and others. To the older race, the practical Naturalists, "who hewed the wood and drew the water," and thus furnished many of the data which enabled these eminent philosophers of the new race, in addition to their own good work, to generalise on the results;—to the older race, which includes Bell, Bowerbank, Alder and Hancock, Forbes and Hanley, Gwyn Jeffreys, Yarrell, and others, belongs Mr. Gosse, marching in a no less honourable company. Wherever Marine Zoology is studied, for many a long year to come, the name of Gosse will be a household word. A thoroughly good man, a courteous gentleman, a sincere friend, and a profound Naturalist—what an example to follow!

Mr. Gosse leaves a widow and an only son to deplore his loss. His son (Mr. Edmund Gosse), who inherits his father's gift of language, has already won lasting laurels in other walks of literature.

W. R. H.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 281.)

The next step in our history takes us to the neighbourhood of Birmingham, where the parishes of Yardley, King's Norton, and Northfield, which occupy the north-east angle of Worcestershire, adjoin on the south the borough of Birmingham and county of Warwick. The hamlet of Balsall Heath in King's Norton parish is, at its most northerly point, within a mile of the centre of the town; south of it is the hamlet of Moseley. About a mile to the south-east of Moseley Church, but in the parish of Yardley, was an open tract of common, partly covered with bog, called Moseley Common, the remnant of a still larger tract, known as Moseley Wake Green. It produced some of the rarest plants in the county, such as *Drosera rotundifolia*, *Radiola millegrana*, *Hypericum elodes*, *Parnassia palustris*, *Carduus pratensis*, *Vaccinium Oxycoccus*, *Menyanthes trifoliata*, *Scutellaria minor*, *Anagallis tenella*, *Centunculus minimus*, *Narthecium ossifragum*, *Rhyncospora alba*, *Eriophorum vaginatum*, *Osmunda regalis*, *Lycopodium Selago*. The Commons Preservation Society not being at that time in existence, the Common was enclosed and drained in or about the year 1842, and all its characteristic plants destroyed.

It is strange that none of the above species, with the exception of *Osmunda regalis*, were noticed at Moseley by Withering, although the Common was within three miles of his house. We are indebted to the late Dr. William Ick, Curator of the old Philosophical Institution of Birmingham, for the first notice of Moseley plants. It is contained in a paper entitled "Remarkable Plants found growing in the vicinity of Birmingham in the year 1836," published in "The Analyst," Vol. VI., 1837, pp. 20-28. Miss Mary Anne Beilby, the present Mrs. Avery, of Edgbaston, who commenced the study of Botany under the guidance of the late Mr. Edward White Benson, the father of the present Archbishop of Canterbury, was a frequent visitor to Moseley Common in the years 1835 and 1836. She drew up a list of plants, which was contributed by Mr. Benson to the same volume of "The Analyst" as that above referred to, where it will be found at pp. 293-296. The list may be easily overlooked, as it is not noticed in the index. A further list by Dr. Ick was sent to the *Midland Counties Herald* on the

5th August, 1838. This contains, among others, some plants from the neighbourhood of Stourbridge, and many of Miss Beilby's records are repeated. A few additional Moseley plants are contained in a list by Mr. Samuel Freeman, dated October, 1841, published in the "Phytologist" for July, 1842, 1st Series, Vol. I., p. 261, and a few others in Edward Newman's list of Worcestershire ferns, "Phytologist," March, 1843, Vol. I., pp. 512-514. It may be concluded from the last two lists that the *Osmunda* was growing at Moseley at least as late as 1841.

In analysing these lists there is some difficulty in distinguishing the Worcester records from those of Warwick. A locality frequently mentioned is Vaughton's Hole. This was in Warwick, close to the edge of the borough, and is now entirely covered with houses. A footpath, with two branches, led from it in a southerly direction, through meadows on the Worcester side of the River Rea, across Edgbaston Lane to Cannon Hill on the one side, and to Moseley Hall on the other. Many plants are noted from Edgbaston Lane and Avern's Mill. The former is in both counties, the boundary running along the Rea, which has two branches crossing the lane, Avern's Mill standing between them in the county of Warwick.

In the following extracts from the lists above mentioned, the Worcester records only have been selected, together with the few others possibly belonging to the county, or very near the border.

WILLIAM ICK, PH.D., "THE ANALYST," VOL. VI., 1837,
PP. 22-28.

- * *Ranunculus hederaceus*. Meadows near Vaughton's Hole. This plant, though rare in some localities, is very common around Birmingham. (*Probably in Worcester.*)
- * *Corydalis lutea*. On an old wall in Edgbaston Lane.
- * *Cardamine amara*. Edge of a stream in a meadow near Moseley Park.
- * *Reseda Luteola*. Plentiful among the coal pits, near the road side, between Oldbury and Dudley.
- Cerastium aquaticum*. On rubbish near Moseley Park.
- * *Malva moschata*. Edgbaston Lane, opposite the gates of Moseley Park.
- * *Hypericum pulchrum*. Meadow near Moseley Park.
- * *H. quadrangulum*. Same place.
- * *Linum catharticum*. Moseley Common.
- * *Genista tinctoria*. Meadow near Selly Hall Park.
- Tormentilla reptans* (*Potentilla procumbens*). Edgbaston Lane, near Avern's Mill. (*Possibly in Worcester.*)

- * *Alchemilla vulgaris*. A meadow about 500 yards beyond Vaughton's Hole, crossed by a footpath to Moseley Park.
- * *Sanguisorba officinalis*. Same locality as the preceding; common in meadows on the Edgbaston side of Birmingham.
- Epilobium parviflorum*. Near King's Norton.
- Oenanthe fistulosa*. Brook side, Yardley.
- * *Torilis infesta*. Near Oldbury.
- * *Valeriana dioica*. A meadow about 500 yards beyond Vaughton's Hole, crossed by a footpath to Moseley Park.
- * *Carduus eriophorus*. Grounds near Dudley Castle.
- * *Tragopogon pratensis*. New road to King's Norton, 3 miles from Birmingham.
- * *Conyza squarrosa*. Near Dudley Castle.
- * *Chlora perfoliata*. The grounds about Dudley Castle.
- * *Atropa Belladonna*. Left hand side of the court yard of Dudley Castle, close to the wall, August 3rd, 1835; July 26th, 1836.
- * *Linaria Cymbalaria*. On the ruins of the keep at Dudley Castle.
- * *Veronica Anagallis*. Swampy ground near the bridge at Yardley.
- Galeopsis Tetrahit*. In the Halesowen Road.
- * *Echium vulgare*. Plentiful on the ruins of Dudley Castle.
- * *Lysimachia nemorum*. In a meadow near Moseley Park.
- † *Polygonum amphibium*. In the stream midway between Avern's Mill and the Pebble Mill, Edgbaston. *This habitat is in the county of Warwick, very near the Worcester boundary.*
- * *Juncus bufonius*. A damp lane between Stirchley Street and King's Norton.
- J. lamprocarpus*. In the same place as the last.
- * *Butomus umbellatus*. The brook in Edgbaston Lane near Avern's Mill. (*Possibly in Worcester.*)
- * *Scirpus sylvaticus*. Side of the brook nearly opposite Avern's Mill, Edgbaston Lane. (*Possibly in Worcester.*)
- * *Blechnum boreale*. Moseley Common, near the new road.

MISS MARY ANNE BEILBY, "ANALYST," VOL. VI., 1837,
PP. 294-296.

Communicated by E. W. Benson. Previous records by Dr. Ick omitted.

- * *Thalictrum flavum*. Meadows near the Rea. (*Possibly in Worcester.*)
- * *Fumaria capreolata*. Sandy lanes. (*Possibly in Worcester.*)
- * *Coronopus Ruellii*. Lanes near Yardley.
- * *Viola palustris*. Bog on Moseley Common.
- * *Drosera rotundifolia*. Bogs on Moseley Common.
- * *Dianthus deltoides*. Lanes near Moseley, but rare.
- † *Arenaria tenuifolia*. Gravelly fields, Yardley. (*I suspect an error.*)

- † *Stellaria nemorum*. Field in Hob Lane, Yardley. (*Must be an error.*)
- Hypericum elodes*. In a drained mill pool on Moseley Common.
- * *Linum catharticum*. Balsall Heath.
- * *Radiola millegrana*. Moseley Wake Green.
- * *Rhamnus Frangula*. Moseley Common.
- * *Melilotus officinalis*. Fields near Moseley occasionally.
- * *Ornithopus perpusillus*. Moseley Wake Green.
- * *Potentilla Comarum*. Pool on Moseley Common.
- * *Lythrum Salicaria*. Hay Mill Brook, Yardley.
- Myriophyllum spicatum*. Rea, near Vaughton's Hole. (*Possibly in Worcester.*)
- * *Saxifraga granulata*. Lanes near Yardley.
- * *Parnassia palustris*. Bogs on Moseley Common.
- * *Hydrocotyle vulgaris*. Moseley Wake Green.
- * *Helosciadium inundatum*. Moseley Wake Green.
- * *Silaus pratensis*. Field in Hob Lane, Yardley.
- * *Cnicus (Carduus) pratensis*. Moseley Common and field in Hob Lane.
- * *Serratula tinctoria*. Near the Rea, Balsall Heath.
- * *Pulicaria dysenterica*. Common at Yardley.
- Eupatorium cannabinum*. Yardley.
- * *Condrilla (Lactuca) muralis*. Stony Lane.
- * *Senecio sylvaticus*. Lanes, common. (*Probably in Worcester.*)
- * *Oxycoccus palustris*. Bog on Moseley Common.
- * *Erica Tetralix*. Moseley Common.
- * *E. cinerea*. Moseley Common.
- * *Menyanthes trifoliata*. Pond on Moseley Common.
- * *Veronica scutellata*. Moseley Wake Green.
- * *Pedicularis palustris*. Bog on Moseley Common.
- * *P. sylvatica*. Lanes near Moseley.
- * *Melampyrum pratense*. The Beech Woods. (*Probably at Warley.*)
- * *Mentha gentilis*. Yardley.
- Stachys arvensis*. Yardley-field.
- * *Nepeta Cataria*. Yardley.
- * *Scutellaria galericulata*. Pond on Moseley Common.
- * *S. minor*. Bog on Moseley Common.
- * *Anchusa sempervirens*. Near Moseley Hall.
- * *Anagallis tenella*. Bog on Moseley Common.
- * *Centunculus minimus*. Moseley Wake Green.
- * *Plantago Coronopus*. Moseley Wake Green.
- * *Polygonum Bistorta*. Lane from Cannon Hill to Moor Green.
- * *Triglochin palustre*. Meadows near the Rea.

- * *Colchicum autumnale*. Common in wet fields near Yardley.
- * *Narcissus Pseudo-narcissus*. Fields near Yardley.
- * *Allium ursinum*. Fields and brook sides near Moseley and Yardley.
- * *Narthecium ossifragum*. Bog on Moseley Common.
- Rhyncospora alba*. Bogs on Moseley Common.
- * *Eriophorum vaginatum*. Bog on Moseley Common.
- * *E. angustifolium*. Bog on Moseley Common.
- * *Carex vulpina*. Shady lanes. Common.
- * *C. stellulata* Moseley Common.
- * *C. remota*. Moseley Common.
- * *C. ovalis*. Moseley Common.
- * *C. flava*. Moseley Common.

It is doubtful whether the type or the var. lepidocarpa is intended here.

- C. binervis*. Moseley Common.
- C. præcox*. Moseley Common.
- C. panicea*. Moseley Common.
- C. cæspitosa (Goodenovii)*. Moseley Common.
- * *C. sylvatica*. Edgbaston Lane, opposite Cannon Hill gates.
- C. lævigata*. Moist field at Highgate, not far from the Rea.
Possibly in Worcester.
- * *C. Pseudo-cyperus*. Ditch in a field on the Balsall Heath side of the Rea.
- C. vesicaria*. Pond on Moseley Common.
- C. acuta*.)
- C. paludosa*. { Bank of the Warwick Canal. *Possibly in Yardley*
 and Worcester.
- * *C. riparia*.)
- Molinea cærulea*. Moseley Common.
- * *Melica uniflora*. Common in shady lanes.
- * *Asplenium Adiantum-nigrum*. Green Lane, Yardley.
- * *A. Trichomanes*. Green Lane, Yardley.
- * *A. Ruta-muraria*. Old walls, Hall Green, but not common.
- * *A. Filix-fœmina*. Lanes. Common.
- * *Scolopendrium vulgare*. Lanes near Yardley. Occasionally.
- Aspidium lobatum*. Yardley.
- Var. of A. aculeatum.*
- * *A. Oreopteris*. Moseley Common.
- † *A. cristatum*. Moseley Common.

I suspect an error for A. spinulosum.

- * *A. dilatatum*. Moseley Common.
- * *Osmunda regalis*. Moseley Common.
- Lycopodium Selago*. Bog on Moseley Common.

(To be continued.)

A CHAPTER IN THE PHYSICAL GEOGRAPHY OF THE PAST.

PRESIDENTIAL ADDRESS
GIVEN TO THE BURTON-ON-TRENT NATURAL HISTORY
AND ARCHÆOLOGICAL SOCIETY.

BY HORACE T. BROWN, F.G.S., F.I.C., F.C.S.

(*Concluded from page 287.*)

Thus we see all the evidence is in favour of the comparative stability of the land areas in Carboniferous times, and the gradual bending down of the floor upon which the sediment was deposited.

I have now given you a condensed account of the leading facts connected with the laying down of the materials forming the Carboniferous Rocks of this part of Europe, and have shown you how the record of the conditions prevailing during their deposition is written in indelible characters in the rocks themselves.

My sketch would, however, be incomplete if it did not include some reference to the agencies which have upheaved these once horizontal strata, and have brought them into the elevated position which they now occupy in the hill country of Northern England.

We have already seen how, in the Pennine Range of hills, the rocks composing them are now arranged in a series of folds or corrugations. With a difference in degree only we always find this tendency to ridge and furrow arrangement in all strata which have been in any way disturbed, but it attains a maximum of development in mountainous districts, where the disturbing forces have been great; the folds, in such cases, assuming great height, and bending on themselves in a very abrupt and remarkable manner.

The more this folded structure of the earth's crust is studied the more evident it becomes that it has not been brought about by any subterranean forces acting vertically upwards. We can only find a reasonable explanation of the complicated, and often inverted foldings of mountainous districts, by assuming that the force was a *lateral* one, and that it has ridged up the rocks, just as a piece of paper or a cloth is puckered when it is laid flat upon the table and the fingers pressed upon it with a slight sliding movement.

That nearly all the elevations of old sea bottoms into hills and mountains have been produced by lateral thrust all

geologists are agreed, but on the question as to how that lateral thrust has been brought about there are at least two distinct opinions.

The hypothesis, which has up to recently found most favour with geologists, and which taken by itself perhaps explains the greatest number of observed facts, is the so-called hypothesis of *Secular Contraction*.

That the earth was originally a molten mass, which has gradually cooled from within outwards, is rendered highly probable from certain astronomical considerations; and that its interior has still a very high temperature is indicated both by volcanic phenomena, and by the fact that the deeper we go down the hotter it becomes; the increment of temperature being about 1° Fahr. for every fifty feet of depth. The hot interior or nucleus must still be cooling down by conduction of its heat through the solidified crust and its dissipation into space, and this cooling must also mean *contraction*. There is, consequently, a constant tendency for the interior nucleus to separate itself from the outer and cooler shell, and since it is manifest that the shell cannot stand alone, it must tend by the power of gravitation to adapt itself to the "diminishing circumference of the contracting interior," and in its efforts to do so, great lateral pressure is evoked, which bends, breaks, and ridges the crust along certain lines. Thus, on this hypothesis, have been produced the great lines of elevation of most of our mountain ranges. They may not inaptly be compared with the wrinkles on the skin of a drying apple, for the skin of the apple becomes wrinkled in its efforts to adapt itself to the shrinking interior of the fruit.

We should certainly expect that the elevation of ridges on the earth's surface, if these are to be looked upon as the expression of secular contraction, would take place along the lines of least resistance, where, in fact, the earth's crust is the thinnest; it is, consequently, a little startling at first to find that the great elevations have nearly all taken place where sedimentation has been the *thickest*, and where we might expect the crust of the earth to be the strongest. The difficulty, however, disappears on examination, and for the explanation we will return once more to the Carboniferous strata of the Pennine area. These, as we have seen, were laid down in a great trough which gradually bent more and more downwards as more sediment accumulated in it. Such a great and constantly deepening depression in the earth's surface is called a *geosynclinal*, and in such troughs have been deposited, sometimes to a thickness of miles, the strata which are now elevated in our mountain chains.

As the great geosynclinal bends more and more downwards, the first formed and lowest strata are carried through zone after zone of constantly increasing temperature, which at last is sufficient to melt, or at any rate to soften, the deepest part of the inverted arch. The very keystone of the arch is then gone, and it is unable to withstand the great lateral strains due to the secular contraction of the earth, and forthwith the elevation of the mass begins.

On the second hypothesis, the lateral pressure which has brought about the folds and wrinkles in the earth's crust is attributed to the expansion of the mass of sediment when it is carried into the zones of higher temperature, as the geosynclinal, or great earth trough, bends more and more downwards under the weight of the superincumbent strata. This hypothesis has, within the last year or so, come into more prominence, owing to the appearance of a most suggestive work, by Mr. Mellard Reade, "On the Origin of Mountain Ranges," to which I must refer any of you who may wish to gain further information on the subject.

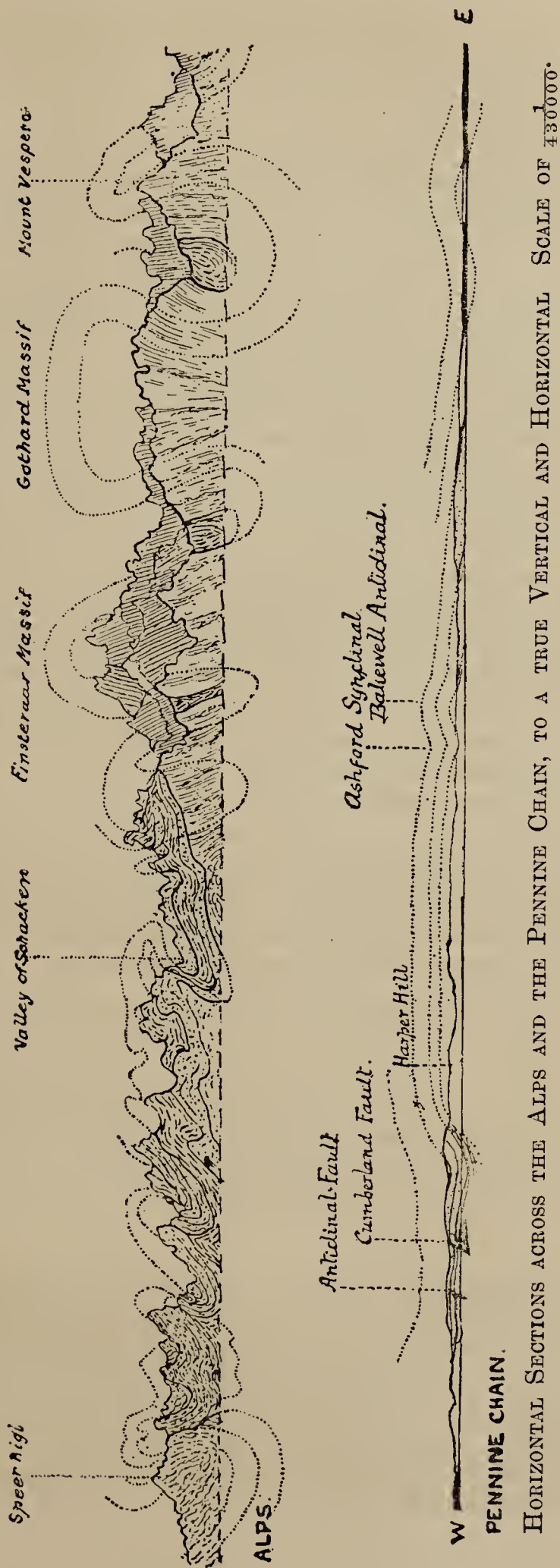
These two theories, framed to account for the upheaval of vast thicknesses of strata deposited on old sea bottoms, are, in my opinion, not so antagonistic as they appear at first sight. I believe that further research will show that *both* agencies, *i.e.*, secular contraction, and expansion of the sediments by heat, have had a hand in the work.

In all highly folded mountainous districts we find that the rocks are bent in such a way as to indicate that the lateral force was exerted more on one side of the elevated region than on the other; that the range in fact exhibits a "shoving" side and a resisting side. Our Pennine Range is no exception to this rule. On its western side, as indicated in our diagram, the corrugations and faulting are much more pronounced than on the eastern side in the colliery districts of North Derbyshire and South Yorkshire, where the inclination of the strata from the centre of the great anticlinal arch is much more even and regular.

In order that you may have a due idea of the proportion of the Pennine folding to that of a lofty range like the Alps, I must refer you to the sections in the adjoining plate, drawn to a true scale of $\frac{1}{430,000}$, both vertically and horizontally.

You may now ask, at what period of the world's history did all this folding of our English Carboniferous Rocks take place?

I need scarcely tell you that geologists cannot reckon by the ordinary standard of years and centuries. They can only refer geological occurrences to certain great periods



coincident with the laying down of masses of strata, which for various reasons they are agreed to consider as belonging to one geological age.

The strata which are found succeeding the Carboniferous Rocks in upward succession are known as the *Permian*, and it is manifestly possible, by observing the position of these latter rocks relatively to the underlying Carboniferous, to ascertain if the great earth movements which produced the Pennine Anticlinal were *anterior* to the deposition of the Permian or *subsequent*. If, for instance, we find that the overlying Permian does not participate in the great folds of the underlying rock, or if we find great faults, which it can be shown have resulted from the Pennine upheaval, affecting the Carboniferous Rocks and not the overlying Permian, it is evident enough that the Pennine uplift must have taken place *prior* to the Permian epoch.

Nearly twenty years ago Professor Hull came to the conclusion that the folding of the rocks in the Pennine Chain was of two distinct ages; whilst admitting that the east and west foldings were of pre-Permian age, he contended that the north and south folds must have been produced after the deposition of the Permian. The unsoundness of the latter opinion was shown not very long ago by Mr. E. Wilson and Mr. J. J. H. Teall, who instanced proof, that the north and south flexures must also be considered as pre-Permian. I am inclined to dwell upon this point for a moment, since I think our own neighbourhood affords an opportunity of testing the question, even better perhaps than some of the districts selected by the geologists I have named.

I have stated that the north and south corrugations of the Pennine area may be traced southward into the region of our Ashby Coalfield. Here we have also certain beds which I have recently proved to be of Permian age, and which were evidently not laid down until all the great* north and south earth movements of the Carboniferous period had attained a maximum, thus leading irresistibly to the conclusion that the

* It is too often assumed by geologists that the common arrangement in a disturbed district of folds and faults running at right angles to each other, forming what are known as a *conjugate* series, must have been produced by two distinct acts of lateral compression. It seems to me that the key to these phenomena is to be found in the beautiful experiments of Daubrée on the influence of torsion and pressure upon the fracture of solid bodies, and that conjugate series both of faults and folds are best explained on the supposition of their contemporaneous origin.

Pennine upheaval was entirely pre-Permian. On this subject I may possibly have more to say to you later on in the session.

You may now feel inclined to ask, What is the use of all this? How can a knowledge of the distribution of land and water in a period removed from our day by perhaps millions of years, be of more material service to the human race than, say, a knowledge of the conformation of the continents of Jupiter and Saturn? I would answer that these are all subjects well within the legitimate aim of science, and that her votaries need seldom trouble themselves about the ultimate utility of their discoveries. Let but the work be good, thorough, and honest, no matter whether it be on the structure of the mountains of the moon, the internal economy of a cockroach, or the optical effects of a crystal, the worker may be well assured that his hardly-earned knowledge will some day be put to good account; and in pursuing knowledge for its own sake he has his immediate reward in the ever-enlarging views of the universe and of its great Designer, which are engendered by constant and loving communion with Nature.

It would not, however, be difficult to show a great and immediate advantage to be derived from such enquiries as we have been making to-night, an advantage which I think would satisfy even the most persistent of Utilitarians; for it is evident that upon an accurate knowledge of the original extent and present limits of the various members of the great Carboniferous series of rocks must depend the proper direction of capital in the exploration of the vast mineral wealth they contain, and upon which the material prosperity of our country so largely depends.

Wayside Notes.

THE DOCTRINE OF EVOLUTION.—In the "Midland Naturalist" for September, 1887, a letter appeared from Mons. James Grosclande, C.E., of Paris, to Mr. W. R. Hughes, F.L.S., President of the Sociological Section of the Birmingham Natural History and Microscopical Society. It contained the particulars of the formation of a society in Paris for the study of the Doctrine of Evolution and the Science of Society, as set forth in the Synthetic Philosophy of Mr. Herbert Spencer. After an interval of fifteen months a further communication has been received, bringing news that the society is in a

flourishing condition and making good progress. In addition to this, it is gratifying to hear that another has been established on similar lines in New York, under the title of the Brooklyn Ethical Association. The secretary, Mr. James A. Skilton, prior to any definite settlement of their future programme, wrote to Mr. Herbert Spencer, stating what they proposed to do, and asking his approval and advice. This correspondence Mr. Herbert Spencer sent to Mr. Hughes, with the request that he would assist Mr. Skilton with suggestions, and give him an account of the working of the Sociological Section in Birmingham. Mr. Hughes at once complied, and has received the following letter:—

“NEW YORK,

“October 8th, 1888.

“DEAR SIR,—I was very glad to learn that not only Mr. Spencer but yourself and others were interested in what we are trying to do in behalf of Evolution. Our arrangements are so nearly perfected that we commence on Sunday evening next, October 14th, in accordance with our programme.

“The publications you mention in your letter came duly to hand, and have interested us much, for which please accept my thanks. Mr. Spencer’s letter in reply to mine, as well as your own, will be read at the opening of the discussion next Sunday evening.

“Yours truly,

“(Signed) JAMES A. SKILTON.”

The programme of the Brooklyn Ethical Association is arranged on exceedingly broad lines, and embraces the whole range of Evolution. The various branches are taken, one each evening, in the form of a paper, followed by discussion, in order that a comprehensive view of the theory may be gained. Later on, when this purpose is served, each branch will receive its due attention; the main one, Ethics, always being the point to which their work will tend. It is very encouraging to the student of Sociology to find that the science is gathering adherents in other lands, and that though slowly, the esteem in which it is held is surely gaining ground. We augur good results from the establishment of our brother society in America, and heartily wish it success.

HERBERT STONE.

BOTANICAL NOTES FROM STROUD.—Among a large number of flowering plants observed in this neighbourhood during the summer months, by some members of the Stroud Naturalists’ Club, the following less common plants are here recorded for the purpose of comparison with other districts:—*Anemone Pulsatilla*, *Ranunculus arvensis*, *Caltha palustris* var. *Guerangerii*, *Helleborus foetidus*, *Aquilegia vulgaris*, *Aconitum Napellus*, *Nasturtium amphibium*, *Cardamine amara*, *Diploxys muralis*, *Thlaspi arvense*, *T. perfoliatum*, *Stellaria aquatica*, *Arenaria tenuifolia*, *Sagina apetala*, *Althæa hirsuta* (as a weed in a garden), *Geranium pyrenaicum*, *G. columbinum*, *Euonymus*

europæus, *Pyrus Aria*, *Saxifraga granulata*, *Chrysosplenium alternifolium*, *Bryonia dioica*, *Sambucus Ebulus*, *Galium Mollugo*, *Asperula cynanchica*, *Valeriana dioica*, *Dipsacus sylvestris*, *D. pilosus*, *Inula Helenium*, *I. Conyza*, *Pulicaria dysenterica*, *Lemna gibba*, *L. trisulca*, *Potamogeton densus*, *Carex digitata*, *Anthemis nobilis*, *Senecio erucifolius*, *Cichorium Intybus*, *Picris hieracioides*, *Lactuca muralis*, *Campanula glomerata*, *Specularia hybrida*, *Primula elatior*, *Lysimachia vulgaris*, *L. Nummularia*, *Anagallis cærulea*, *Cuscuta europæa*, *Atropa Belladonna*, *Verbascum nigrum*, *Linaria Elatine*, *L. spuria*, *L. viscida*, *Lathræa squamaria*, *Salvia verbenaca*, *Polygonum Bistorta*, *Daphne Laureola*, *Spiranthes autumnalis*, *Cephalanthera rubra*, *Orchis Morio*, *O. pyramidalis*, *Ophrys apifera*, *O. muscifera*, *Herminium Monorchis*, *Habenaria bifolia*, *Tamus communis*, *Convallaria majalis*, *Fritillaria Meleagris*, *Colchicum autumnale*, *Typha angustifolia*, *Acorus Calamus*.—S. J. COLEY.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—SOCIOLOGICAL SECTION.—Supplementary Meeting, October 4th. The President, Mr. W. R. Hughes, F.L.S., in the chair. Fifteen members present. Mr. W. R. Hughes read his paper on the "Progress of the Doctrine of Evolution during the Past Year," giving an account of the literature that had appeared during that time in connection with the subject, and details of the work done by our own and kindred societies.—Supplementary Meeting, October 18th. Mr. Alfred Browett in the chair. Twelve members present. Miss Byett gave her exposition of the third chapter of the second part of Mr. Spencer's "First Principles," entitled "Space, Time, Matter, Motion, Force," with a resumé of the work of last session necessary to give continuity to the line of reasoning.—Ordinary Meeting, October 23rd. Mr. W. R. Hughes, F.L.S., in the chair. Twelve members present. Miss Davies, who was proposed as a member at a previous meeting, was elected. Mr. Bagnall sent for exhibition, for Miss Gingell, of Dursley, *Hypnum splendens*, *H. rutabulum*, *H. molluscum*, *H. triquetrum*, and *H. squarrosum*. Mr. Grove exhibited *Ag. sulphureus*, from Dawlish; for Miss Gingell, *Ag. spectabilis*, *Clavaria coralloides*, *Craterellus cornucopioides*, *Cortinarius torvus*, *Hygrophorus coccineus*, and *Lycoperdon pyriforme*; for Rev. D. C. O. Adams, *Ag. cartilagineus*, *Cortinarius albo-violaceus*, *Hygrophorus chrysodon*. Mr. Stone read his exposition of Mr. Spencer's essay on the "Ethics of Kant," giving a short criticism of Kant's method, and a brief account of his life and works.—The ANNUAL CONVERSAZIONE was held at the Mason College, on Tuesday, October 30th. One hundred and eighty-two members and friends were present. Among the objects exhibited were a large number of lantern photographs:—microscopical, by Mr. J. Edmonds; flowers, by Mr. C. Pumphrey; and scenes taken during the meeting of the British Association at Bath (including Stonehenge and Salisbury Cathedral), by Mr. C. J. Watson.

Mr. J. E. Bagnall showed a collection of the rare plants of Warwickshire; and Messrs. Marshall and Pumphrey, a collection of Norwegian plants. Mr. Walliker exhibited a fossil stem, *Lepidodendron*, from the stone used for the new Post Office. An interesting and rare exhibit was a case of half-a-dozen Siberian Sand Grouse, belonging to Mr. R. W. Chase, captured this year; Mrs. E. Hopkins, of Chester, contributed some beautiful cards of birds' feathers, arranged so as to show the various forms found in each species; Mr. J. Heaton exhibited a large albatross, which was much admired. Professor Lapworth honoured the Society by contributing a number of maps, on which were delineated the results of his recent investigations into the Ordovician System of Shropshire. A large collection of fungi was shown by the President, who also, in conjunction with Mr. Bagnall, exhibited some interesting old botanical books. Not the least attractive of the objects shown were a number of reptiles, snakes, &c., and their eggs, all gathered within thirty miles of Birmingham, by Mr. Shrive; Mr. Blakemore contributed a small marine aquarium containing a number of beautiful living sea-anemones. During the evening the President delivered a short address, touching upon the growing importance of the theory of evolution in the life of the world, and the impossibility of becoming a fair judge of it without at least that modicum of biological knowledge which a Natural History Society could impart to its members. The room was decorated with plants kindly lent by Hans Niemand.

MICROSCOPICAL SECTION, November 6th. The President, Mr. W. B. Grove, B.A., in the chair. Five new members were proposed. Mr. J. B. Harrison, of Barbados, sent as a present to the Society 5lb. of infusorial earth from the Springfield deposits, some of which were exhibited under the microscope, and promised a good yield of interesting specimens. Mr. W. B. Grove, B.A., exhibited a beautiful clump of *Agaricus rachodes*, an edible fungus, from Sutton. Mr. W. H. Wilkinson, *Usnea barbata* var. *rubiginea*, a rare lichen, collected by Mr. J. N. Dixon, F.L.S., from Dolgelly. Mr. Thos. E. Bolton, *Limnias annulatus*, under the microscope. Dr. Hudson says it is rare; he has only met with it once.—**SOCIOLOGICAL SECTION.**—Supplementary Meeting, November 11th. The President, Mr. W. R. Hughes, F.L.S., in the chair. Eleven members present. Mr. Hughes read a letter from Mr. J. A. Skilton of New York, announcing the opening of the Brooklyn Ethical Association. Mr. Parkes read the seventh chapter of Mr. Spencer's "First Principles," entitled the "Persistence of Relations among Forces."—**BIOLOGICAL SECTION, November 13th.** Mr. R. W. Chase in the chair. Five new members were elected. Mr. W. Wilkinson exhibited the rare *Arctostaphylos alpina*, from the Orkneys, and *Empetrum nigrum*; Mr. J. E. Bagnall, for Miss Gingell, a very large and interesting collection of fungi, among which were *Agaricus nudus*, *Ag. fragrans*, *Ag. butyraceus*, *Ag. maximus*, *Hygrophorus pratensis*, &c.; also mosses such as *Dicranum majus*, *D. palustris*, *Hylocomium splendens*, &c., from Dursley, Gloucestershire. For Mr. G. W. Tait, M.R.C.S., the Touch-me-not, *Impatiens Noli-metangere*, from Knowle. Mr. R. W. Chase, F.L.S., exhibited a complete series of the British *Corvidæ* (Raven, Jackdaw, Rook, &c.), with most interesting notes on their habits, habitats, and distribution, which called forth a long and pleasant discussion, in which Messrs. W. P. Marshall, M.I.C.E., H. E. Forrest, J. Levick, T. H. Waller, B.A., W. Wilkinson, J. Rabone, and J. A. Panton, F.R.S.E., took part, the latter gentleman giving many personal recollections of special interest.

GEOLOGICAL SECTION, November 20th. Mr. T. H. Waller, B.A., B.Sc.,

in the chair. Minutes of last meeting read and confirmed. Election of new member: Mr. T. H. Everton, of Parish Offices, Edmund Street; proposed by Mr. W. R. Hughes, seconded by Mr. W. B. Grove, carried unanimously. Exhibits:—Mr. Waller, on behalf of Mr. Pumphrey, a carnivorous slug, *Testacella haliotide* (common in France); Mr. Bagnall, for Miss Gingell: *Ag. fragrans*, *Ag. hypnophilus*, *Mycena tenuis*, *Ag. geotropus*, &c., moss, *Pterogophyllum lucens*. Mr. Hughes, for Miss Gingell, from Dursley, specimens of locally called Gibraltar rock, amygdaloidal Trap (vesicular). Mr. W. B. Grove, from Sutton, *Ag. flavidus*. A paper was read by Mr. A. Browett on the "Bath Oolite and the Method of Quarrying it." An interesting discussion followed, in which Messrs. Waller, Chase, Marshall, and Hughes took part. On the motion of Mr. Waller, seconded by Mr. Marshall, a cordial vote of thanks was unanimously given to Mr. Browett for his paper. Mr. Wagstaff exhibited some drawings he had made of Polycystina, from the Barbados earth sent by Professor Harrison; he also exhibited a slide of Polycystina which he had prepared for the microscope.—SOCIOLOGICAL SECTION.—Supplementary Meeting, November 22nd. Mr. W. R. Hughes, F.L.S., in the chair. Seventeen members present, including Mr. Alfred Hayes, formerly Secretary to the Section. Professor Poynting delivered his exposition of the three chapters of Mr. Spencer's "First Principles," entitled "The Indestructibility of Matter, the Continuity of Motion, and the Persistence of Force," in which he stated Mr. Spencer's views with great force and clearness, but disputed the soundness of his premises, and maintained, that, in the absence of experiment, Mr. Spencer's conclusions could not be arrived at by *a priori* reasoning, and that the experimental method was of primary and not of secondary importance. An animated discussion followed in which most of those present took part.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—October 22nd. Exhibition of "polarised" objects. A series of objects was shown, including pure and impure cocoa (the latter being adulterated with potato starch), jaw of mackerel, palate of *Trochus*, and a number of objects by Mr. J. Edmonds, with his automatic rotating selenite.—October 29th. The President in the chair. Mr. H. Insley gave a lecture on "Coal and How Mined." After describing at some length the conditions under which a profuse vegetation grew and became water-logged and mineralised, the speaker showed with the aid of a lantern a number of photographs, chiefly of the Hamstead Colliery, those of the underground workings having been taken with magnesium light. They illustrated the difficulties and dangers under which coal was mined, and the various contrivances used to give greater security to life. A vote of thanks to the lecturer closed the meeting.—November 5th. Annual Meeting and President's Address. The following reports were read: the Secretary's, reviewing the work of the year as being very satisfactory; the Treasurer's, that he had a balance of £3 3s. 2d. in hand; and the Curator's; these were received and adopted. On the proposition of Mr. O. Hutchinson, seconded by Mr. J. W. Neville, Mr. T. H. Waller, B.A., B.Sc., was unanimously re-elected President for the ensuing year. Mr. Waller having suitably replied, delivered his address. He said we might advantageously consider what is the object of a society of this kind, and how it could most suitably be followed. His sympathy was not with those who after beginning the study of Natural History spread

themselves out too much. Everyone was the better for a knowledge of natural objects, but it should be the aim of the student to have a definite path. He might sometimes take a bye-lane, but should always come back again. A conchologist would only have interest in Botany as a subsidiary subject, and anyone would find the narrowest subject sufficient for leisure hours. At every meeting there should be something on the edge of what is known. Popular objects interested a meeting, and diffusiveness had its uses, but a special line was the highest development of Natural History. The stock beauties of Nature brought in and interested young members, yet the true object of such study was to find out something more than was already known. After the usual votes of thanks to retiring officers, Messrs. J. Moore and J. Rodgers were unanimously elected Vice-Presidents.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.

—SECTION D. At the evening meeting on Wednesday November 21st, the Chairman, Mr. F. T. Mott, F.R.G.S., read a short paper on "The Amphibians and Reptiles of Leicestershire," which was followed by a discussion on the variation of colour in the frog. Mr. E. F. Cooper believed that fear caused a rush of blood to the skin, thus darkening the colour. Mr. Vice thought that frogs were darker when in water than on the land. It was further suggested that they were probably yellower after casting the skin, and that like the chameleon and some other reptiles they had power to vary their colour at will. The Chairman announced the presentation to the Society, for the special use of Section D, of a cabinet containing 100 microscopic slides of British diatoms, admirably mounted and named, the gift of Mr. F. Bates, who was now unable to attend the meetings of the Section, but desired to express his continued interest in its welfare. The following resolution was moved by Mr. E. F. Cooper, seconded by Dr. Cooper, and carried unanimously:—"That the members of Section D present their cordial thanks to Mr. Bates for his very handsome and valuable gift, and are much gratified to learn that he will remain a member of the Section." The next business was an exhibition of ferns—British and foreign—a number of very interesting collections being displayed, viz.: By Dr. Cooper, fresh fronds of about 20 foreign species; by Mr. Turner, dried specimens of South African and of remarkable varieties of British species; by Mr. Vice, a collection of British species; by Mr. E. F. Cooper, a large collection of British specimens and of foreign ferns mostly grown by himself; by the Chairman, a number of the rarer British ferns, and several series showing the development from the spore; by Mr. J. T. Thorpe, a very fine collection of dried fronds, mostly grown by himself, and mounted on sheets of elephant-folio size. By comparison of the different exhibits much information was gained, and many specimens identified which were previously unnamed. Mr. Grundy then exhibited a living specimen of the curious and rare slug, *Testacella mangei*, which burrows in the soil, feeding upon earth-worms. This specimen was found near Bristol. The Chairman exhibited a specimen of the rare fungus *Geaster Bryantii*, found near Leicester, and some large examples of the very destructive dry-rot fungus, *Merulius lacrymans*, in several stages of its development.

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